Result Section

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This section presents the main estimation results. Table 1 reports the OLS estimates based on Equation (1) from the Methods section, excluding economic control variables and time-related factors. Both the linear and squared terms of remittances as a share of GDP are statistically significant, with the squared term being negative. This indicates an inverted U-shaped relationship between remittances and income inequality, consistent across both inequality measures. This finding aligns with previous literature suggesting that remittances may initially increase inequality but reduce it as they become more widespread and accessible.

Turning to the education variables, the coefficient for ISCED 5–8 (higher education) is negative and statistically significant, indicating that greater access to higher education is associated with lower income inequality. In contrast, the linear term for ISCED 1–3 (basic education) is statistically insignificant, suggesting a weaker or more ambiguous relationship. Additionally, the squared terms for both ISCED 1–3 and ISCED 5–8 are not statistically significant, indicating no evidence of a nonlinear association between educational attainment and inequality in the baseline model. These patterns are consistent across both inequality indicators.

While the baseline regressions reveal a statistically significant nonlinear effect of remittances, the relatively modest R-squared values (0.228 and 0.222) suggest that a substantial portion of the variation in inequality remains unexplained. This may be attributed to the lack of controls for economic structure and time trends. Given the cross-country nature of this analysis, it is important to account for macro-level heterogeneity. As discussed in the Methods section, country or region fixed effects are not applicable due to the sparse and uneven distribution of observations. Instead, a set of ten economic control variables is introduced to better capture structural differences across countries. The results are shown in Table 2.

After including economic control variables, the linear term of remittances becomes negative and remains statistically significant, while the squared term turns insignificant. This indicates that the previously observed inverted U-shaped relationship no longer holds once broader economic conditions are taken into account, and that remittances may be linearly associated with lower inequality. For education, ISCED 1–3 becomes significant in both its linear and squared forms, forming an inverted U-shape—suggesting that basic education

may initially exacerbate inequality before reducing it as access expands. One possible explanation is that, prior to the inclusion of economic controls, cross-country variation in structural economic conditions may have played a more dominant role in shaping inequality outcomes than education itself—thereby obscuring the independent effect of basic education. The coefficient for ISCED 5–8 remains negative and significant, while its squared term is positive but not statistically significant at conventional levels, suggesting a potential U-shaped relationship. The increases in R-squared and F-statistics confirm that the updated model exhibits stronger explanatory power and a better overall fit.

Table 3 builds upon this model by incorporating time-period fixed effects. The core findings remain robust: the linear effect of remittances remains negative and significant, while the squared term remains insignificant; ISCED 1–3 continues to exhibit an inverted U-shaped pattern; and the linear term for ISCED 5–8 remains negative and significant. Notably, the squared term for ISCED 5–8, which was previously only suggestive, now becomes statistically significant and positive, confirming a U-shaped relationship. This should not be interpreted as a fundamental change in the nature of the relationship, but rather as a clearer identification of a pattern that was previously obscured. One plausible explanation is that the effect of tertiary education on inequality may evolve over time. When time effects are not accounted for, this temporal variation may weaken the estimated nonlinearity. Once time-period fixed effects are introduced, the differences across time are better isolated, making the U-shaped relationship more detectable.

To further assess the robustness of the findings, Tables 4 and 5 implement more parsimonious specifications using a reduced set of economic control variables. Table 4 is based on the same model structure as Table 2, but only retains control variables that are statistically significant. The results show that the direction of the remittance and education variables remains consistent with previous models, with only minor differences in significance. The R-squared values decrease slightly, while the F-statistics increase notably, indicating that the simplified model is more efficient and statistically stable. Although these results suggest room for optimizing the selection of control variables, the consistency of the findings across specifications reinforces the credibility and robustness of the core conclusions.

Table 5 extends this simplified model by incorporating time-period fixed effects. The results closely mirror those of Table 3: the remittance variable remains negative and significant, education variables retain their direction and significance, and the squared term of ISCED 5–8 continues to be significant—further confirming the presence of a U-shaped relationship under a streamlined model. These findings demonstrate that the core conclusions do not depend on any particular set of control variables and remain structurally consistent across different model specifications.

In order to visualize and further examine the conclusions drawn from the regression results, we generate residual plots. For Remittances/GDP and two education-related variables, we estimate reduced models that exclude the variable of interest, compute the residuals, and then plot their relationship with

the excluded variable. This approach allows us to assess whether the residuals are systematically associated with the omitted variable, and more importantly, whether the functional form observed in the main regression—such as a linear, inverted U-shaped, or U-shaped relationship—is visually supported.

To reduce visual clutter from the large number of observations, we use binned scatter plots. For each graph, both linear and quadratic fitted lines are overlaid. The underlying regression models include all economic controls and time-period fixed effects, consistent with the specification in Table 3.

Since our regression results remain largely consistent across the two different measures of inequality (the Gini index and the income share difference), we focus only on the Gini index as the dependent variable in this section.

Figures 1 to 3 visualize the relationships between the omitted variables and the residuals from reduced models, focusing on Remittances/GDP, basic education coverage (ISCED 1–3), and higher education coverage (ISCED 5–8), respectively. In Figure 1, the linear and quadratic fitted lines appear nearly identical, which aligns with our regression results showing that the squared term for remittances is small and statistically insignificant. This supports our conclusion of a monotonic negative relationship between remittance dependence and income inequality.

By contrast, Figures 2 and 3 display notable differences between the linear and quadratic fits. These patterns visually reinforce the nonlinear relationships identified in our regressions: an inverted U-shaped relationship for basic education, and a U-shaped relationship for higher education.

Table 1: Effect of Remittances on Income Inequality without Controlling for Economic Variables and Fixed Effects

	Standardized Gini	**Top20 − Bottom20**
Remittances/GDP	0.315^{*}	0.270^{**}
	(0.156)	(0.104)
(Remit./GDP)^2	-0.014^{*}	-0.010^{*}
	(0.006)	(0.004)
ISCED 1–3	2.693	1.749
	(2.255)	(1.497)
ISCED 1–3^2	−0.151	-0.102^{+}
	(0.093)	(0.062)
ISCED 5–8	-5.202^{**}	-2.936^{**}
	(1.708)	(1.134)
ISCED 5–8^2	0.443	0.243
	(0.321)	(0.213)
Constant	36.111^{**}	29.393^{***}
	(12.996)	(8.629)
Economic Controls	No	No
Time Period FE	No	No
Observations	558	558
R-squared	0.228	0.222
F statistic	27.071	26.188

Note: Standard errors in parentheses. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 2: Effect of Remittances on Income Inequality with Economic Controls (No Fixed Effects)

	Standardized Gini	**Top20 − Bottom20**
Remittances/GDP	-0.331^{**}	-0.172^{*}
	(0.119)	(0.076)
(Remit./GDP)^2	0.005	0.003
	(0.004)	(0.003)
ISCED 1–3	6.907^{***}	4.557^{***}
	(1.589)	(1.018)
ISCED 1–3^2	-0.245^{***}	-0.162^{***}
	(0.065)	(0.042)
ISCED 5–8	-4.116^{***}	-2.126^{**}
	(1.211)	(0.775)
ISCED 5–8^2	0.506^{*}	0.280^{+}
	(0.226)	(0.144)
Constant	21.686^{*}	19.327^{***}
	(9.087)	(5.820)
Economic Controls	All	All
Time Period FE	No	No
Observations	558	558
R-squared	0.640	0.663
F statistic	64.344	71.073

Note: Standard errors in parentheses. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Included economic controls: Real GDP, GDP per capita, Total investment, Gross national savings, Inflation, Unemployment rate, General government total expenditure, General government net lending borrowing, Current account balance.

Table 3: Effect of Remittances on Income Inequality with Economic Controls and Time Fixed Effects

	Standardized Gini	**Top20 − Bottom20**
Remittances/GDP	-0.501^{*}	-0.268^{*}
	(0.165)	(0.103)
(Remit./GDP)^2	0.009	0.006
	(0.006)	(0.004)
ISCED 1–3	7.589^{***}	5.036^{***}
	(1.620)	(1.105)
ISCED 1–3^2	-0.274^{***}	-0.183^{***}
	(0.060)	(0.042)
ISCED 5–8	-5.999^{**}	-3.199^{**}
	(1.417)	(0.876)
ISCED 5–8^2	0.705^{**}	0.399^{**}
	(0.211)	(0.129)
Economic Controls	All	All
Time Period FE	Yes	Yes
Observations	558	558
R-squared	0.679	0.695
Within R-squared	0.659	0.675
Std. Errors	by: period	by: period

Note: Standard errors in parentheses and clustered by time period. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Included economic controls: Real GDP, GDP per capita, Total investment, Gross national savings, Inflation, Unemployment rate, General government total expenditure, General government net lending borrowing, Current account balance.

Table 4: Effect of Remittances on Income Inequality with Full Economic Controls (No Fixed Effects)

	Standardized Gini	**Top20 − Bottom20**
Remittances/GDP	-0.277^{*}	-0.136^{+}
	(0.118)	(0.076)
(Remit./GDP)^2	0.003	0.002
	(0.004)	(0.003)
ISCED 1–3	5.827^{***}	3.921^{***}
	(1.590)	(1.016)
ISCED 1–3^2	-0.199^{**}	-0.135^{**}
	(0.065)	(0.042)
ISCED 5–8	-3.281^{**}	-1.602^{*}
	(1.206)	(0.770)
ISCED 5–8^2	0.359	0.187
	(0.225)	(0.144)
Constant	23.221^{*}	20.350^{***}
	(9.166)	(5.857)
Time Fixed Effects	No	No
Economic Controls	Partial	Partial
Observations	558	558
R-squared	0.625	0.650
F statistic	82.724	92.210

Note: Standard errors in parentheses. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

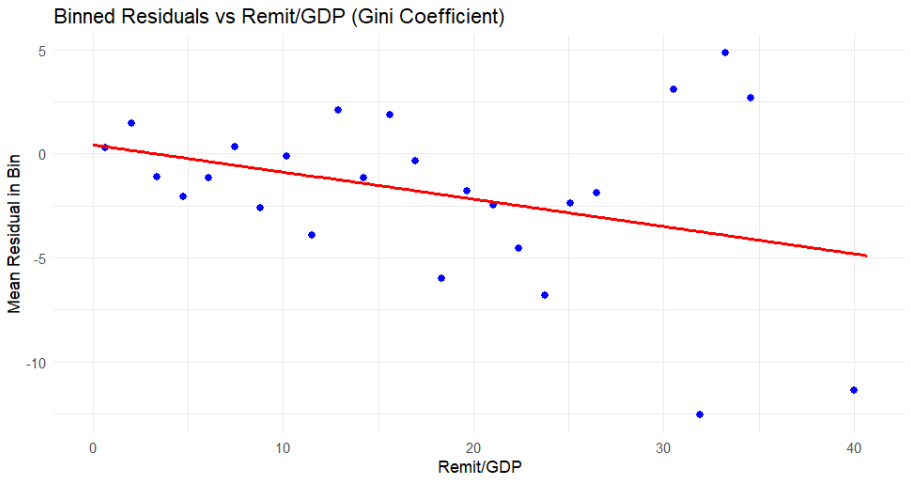
Included economic controls: Real GDP, GDP per capita, Inflation, General government total expenditure, General government net lending borrowing.

Table 5: Effect of Remittances on Income Inequality with Partial Economic Controls and Time Fixed Effects

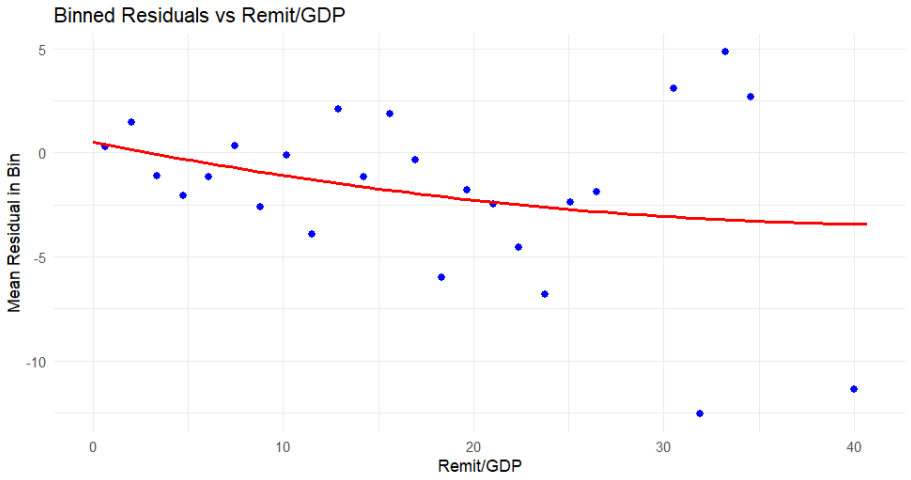
	Standardized Gini	**Top20 − Bottom20**
Remittances/GDP	-0.442^{*}	-0.231^{*}
	(0.155)	(0.097)
$(\text{Remit./GDP})^2$	0.007	0.004
	(0.006)	(0.004)
ISCED 1–3	6.581^{**}	4.468^{**}
	(1.692)	(1.133)
ISCED $1–3^2$	-0.234^{**}	-0.161^{**}
	(0.064)	(0.044)
ISCED 5–8	-4.980^{**}	-2.591^{**}
	(1.170)	(0.732)
ISCED $5–8^2$	0.547^{*}	0.305^{*}
	(0.181)	(0.112)
Time Fixed Effects	Yes	Yes
Economic Controls	Partial	Partial
Observations	558	558
R-squared	0.663	0.682
Within R-squared	0.642	0.662

Note: Standard errors in parentheses, clustered by time period. $^{+}p < 0.1$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Included economic controls: Real GDP, GDP per capita, Inflation, General government total expenditure, General government net lending borrowing.

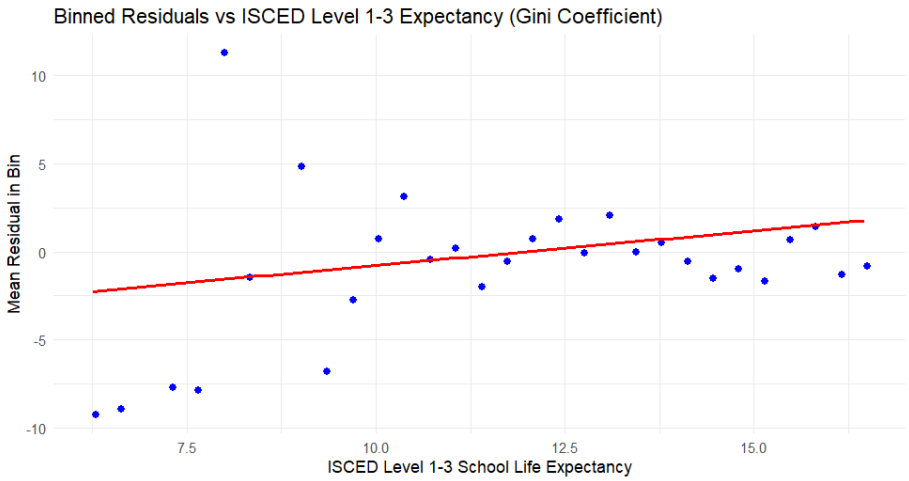


(a) Linear fit: Binned residuals vs Remit/GDP (Gini coefficient)

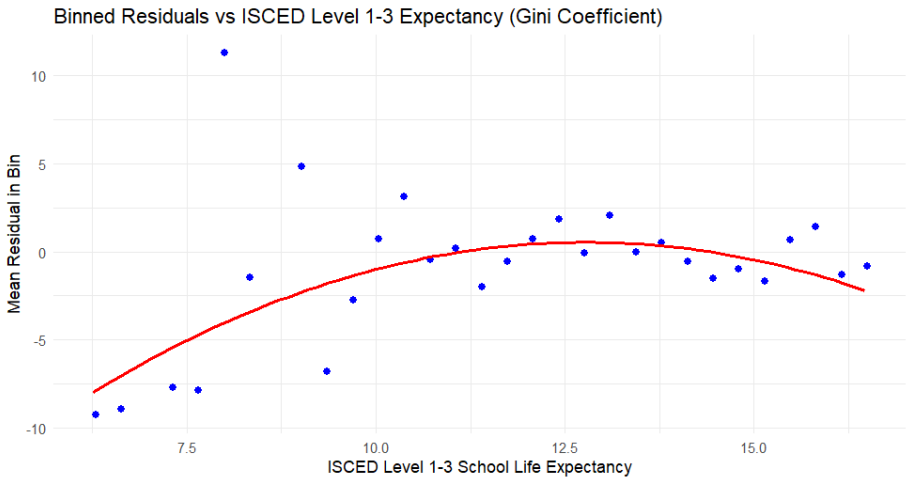


(b) Nonlinear fit: Binned residuals vs Remit/GDP (Gini coefficient)

Figure 1: Comparison of binned residuals vs Remit/GDP: (a) linear fit, (b) nonlinear fit.

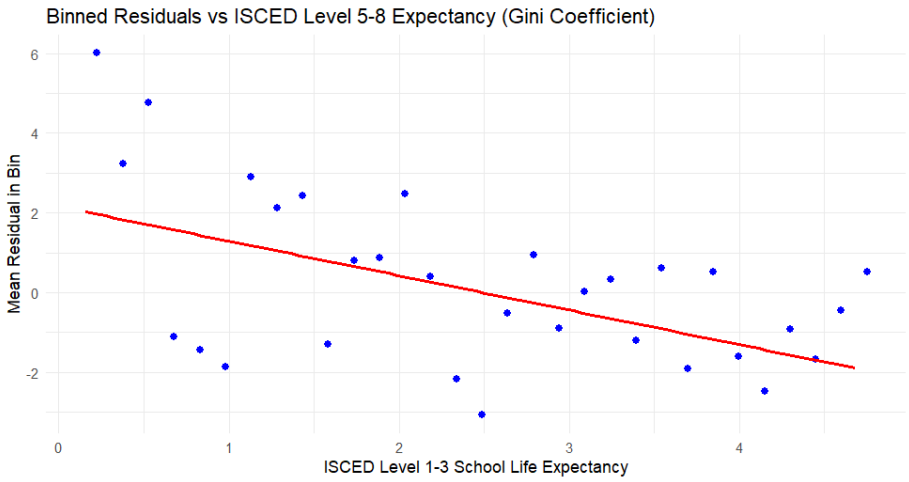


(a) Linear fit: Binned residuals vs ISCED Level 1-3 School Life Expectancy (Gini coefficient)

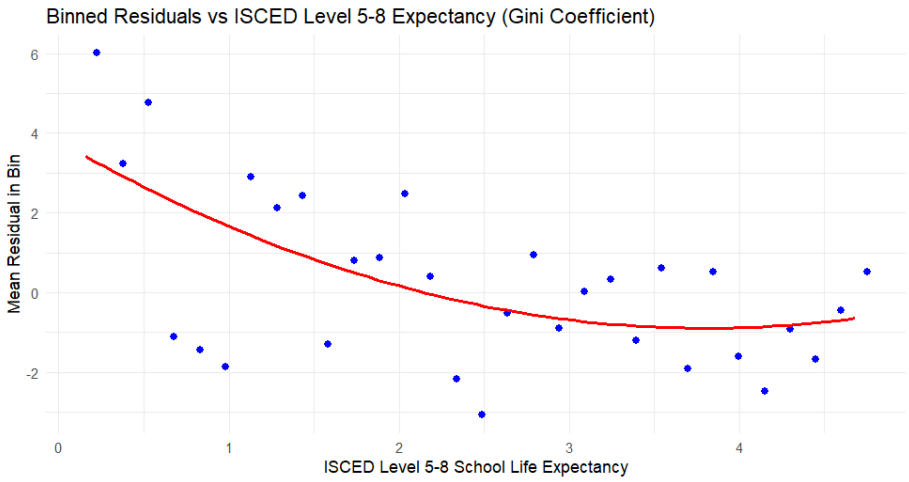


(b) Nonlinear fit: Binned residuals vs ISCED Level 1-3 School Life Expectancy (Gini coefficient)

Figure 2: Comparison of binned residuals vs ISCED Level 1-3 school life expectancy: (a) linear fit, (b) nonlinear fit.



(a) Nonlinear fit: Binned residuals vs ISCED Level 5–8 School Life Expectancy (Gini coefficient)



(b) Linear fit: Binned residuals vs ISCED Level 1–3 School Life Expectancy (Gini coefficient)

Figure 3: Comparison of binned residuals vs school life expectancy: (a) ISCED Level 5–8 (nonlinear fit), (b) ISCED Level 1–3 (linear fit).