Teachers and Inequality: A General Equilibrium Perspective

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Abstract

This paper studies the effects of teachers on income inequality. I establish that declining teachers' human capital amplifies income inequality through three channels: (1) reduced teacher input lowers the human capital supply in future generations, increasing the skill premium and disproportionately benefiting high-skill workers – the *price* channel; (2) scarce teaching resources exacerbate human capital disparities, as parents with lower wages are disadvantaged in the competition for better teachers – the *quantity* channel; and (3) declining teacher quality compounds over time as teachers are drawn from the population – the *dynamic* channel. Calibrated to U.S. data, the model matches quasi-experimental evidence as non-targeted moments. I use the model to analyze the effects of several reforms: redistributing teaching resources, compressing teacher wages, raising teacher qualifications, and increasing teacher supply. I find large differences between short-run and long-run, as well as between partial and general equilibrium consequences, underscoring the importance of a micro-to-macro approach in evaluating education policy impacts.

JEL classification: I24, J24, J31, J45

Keywords: teacher, human capital, inequality

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1. Introduction

Teachers constitute less than 5% of the workforce in most countries, yet their impacts on students' academic performance (Rockoff, 2004; Rivkin et al., 2005) and long-term economic outcomes (Chetty et al., 2014a) are profound. The attraction and retention of high-quality teachers, alongside the effective allocation of teaching resources, hold significant implications for efficiency and inequality of the aggregate economy, and are the focus of policymakers.

The classic approach to analyzing such education policies is to estimate the impacts on teachers and students, leveraging variations in exposures due to institutional settings. Yet, given that teachers shape the entire human capital distribution, such partial equilibrium analysis could miss important general equilibrium effects through endogenous prices and human capital distribution.

In this paper, I study the impacts of teachers on inequality through the lens of an overlapping generations model with occupation selection and child human capital formation. In the model, altruistic parents select occupations (teachers or workers) and effort levels to maximize dynastic utility. Children's human capital hinges on the amount of teachers' human capital they are exposed to, which in turn is determined by parental tax contributions (Zheng and Graham (2022)) and the economy's total teaching resources available. The government posts teaching jobs, establishes human capital requirements for teachers, regulates the return to human capital in teaching, allocates teaching resources across households, and collects taxes to pay for teachers' wage bill. Importantly, wages for each occupation and the shadow price of teaching resources are endogenously determined in general equilibrium to clear labor and education markets. Human capital evolves dynamically, shaped by exogenous ability shocks, prior distributions, and current teaching resource allocations.

I establish that declining teachers' human capital exacerbates income inequality via three key channels. First, diminished teacher input reduces future generations' human capital, increasing the skill premium due to rising marginal productivity, thus favoring high-skill workers and widening income disparities—the *price* channel. Second, intensified competition for scarce teaching resources disproportionately limits human capital accumulation for children from lower-income households, widening the human capital gaps and elevating income inequality—the *quantity* channel. Third, as teachers are drawn from the population, declining teachers' human capital perpetuates and amplifies over time—the *dynamic* channel. Moreover, the reason behind the declining teachers' human capital matters. For instance, if it is driven by high-skill individuals leaving teaching for other professions, such outflow generates contemporaneous changes in skill prices, and thus creates a wedge between short-run and long-run outcomes.

The model parameters are disciplined by U.S. data, matching cross-sectional moments from the Current Population Survey (CPS) and the National Longitudinal Survey of Youth (NLSY), and incorporate estimates from empirical studies, such as Lefgren et al. (2012) and Chetty et al. (2014a). As a non-targeted moment, it replicates differential child human capital responses to teacher wage compression, aligning with quasi-experimental evidence from duty-to-bargain laws in Lovenheim and Willén (2019) using Census micro data, as well as estimates from a teachers' pay-for-performance experiment by Lavy (2020).

In the counterfactual analysis, I evaluate four education policies: a 20% more equitable redistribution of teaching resources, a 20% compression of teacher wages, a 5-percentage-point increase in teacher human capital requirements, and a rise in the teacher share from 4% to 5%. Relative to the baseline economy, outcomes are compared across long-run general equilibrium, fixed human capital distribution, and next-generation scenarios to underscore the importance of endogenous prices and human capital dynamics.

I find that policies enhancing teaching resources or quality, such as equitable resource distribution or stricter teacher qualifications, markedly reduce long-run inequality. For example, equitable redistribution lowers the Gini coefficient by 4.5% and the 90–10 income ratio by 6.7%, fueled by a 6.1% rise in average human capital and an 8.1%

drop in the skill premium. Raising teacher qualifications increases teaching resources by 18.6%, cutting the Gini coefficient by 0.9%. Conversely, teacher wage compression raises the Gini coefficient by 0.9%, disproportionately harming lower-income families' children. Increasing the teacher share boosts average human capital by 1.64% and reduces the 90–10 income ratio by 2.5% in the long run, but inequality rises in the one-generation scenario due to labor market crowding out.

Importantly, I find that one-generation or fixed-distribution analyses produce substantially different outcomes compared to long-run policy effects. First, focusing solely on short-term results underestimates the magnitude of impacts by overlooking the *dynamic* channel of human capital accumulation across generations. For instance, redistributing teaching resources more equitably increases average human capital by 2.7% in the next generation, but the long-run general equilibrium effect is a 6.1% increase—more than double the short-term impact. Second, partial-equilibrium models may produce misleading predictions, even in terms of direction, as they fail to capture skill premium adjustments, which are inherently redistributive. For example, increasing teacher qualifications raises the Gini coefficient of income by 1% in the next generation, yet the long-run general equilibrium effect is a 1% decrease.

To summarize, the main results underscore the critical need to incorporate general equilibrium effects and advocate for a micro-to-macro approach to evaluating education policy effects.

Literature

The paper contributes to the macroeconomic literature on education markets, teachers, and inequality, such as Fernandez and Rogerson (2003), De la Croix and Doepke (2004), Gilpin and Kaganovich (2012), Kotera and Seshadri (2017), Zheng and Graham (2022), Artige and Cavenaile (2023), and more recently, Chyn and Daruich (2022). It makes three distinct contributions. First, while prior studies emphasize household demand for education resources, this work highlights the supply side adjustments through occupational choice into teaching and explores the compounding effects of teacher quality changes.

Second, it is the first to incorporate general equilibrium effects driven by endogenous skill premium adjustments. I find that the endogenous skill premium is critical in driving the differences between one-generation and long-run effects on inequality. Third, it introduces a flexible framework to evaluate diverse education policies, including redistributing teaching resources, compressing teacher wages, raising teacher qualification thresholds, and expanding teacher job postings.

This paper also contributes to the empirical literature in labor and education economics examining the teacher labor market and its effects on student outcomes. Key related works include Hoxby (1996) and Hoxby and Leigh (2004) on teacher unions, Bacolod (2007) and Corcoran et al. (2004) on women's alternative career paths, and Lovenheim and Willén (2019), Lavy (2002), Lavy (2020), Biasi (2021), and Tincani (2021) on collective bargaining and performance-based pay. The literature consistently finds that incentivizing high-quality teachers enhances teacher effectiveness and boosts student outcomes, particularly for disadvantaged groups. To my knowledge, this is the first paper to leverage these single-generation estimates within an overlapping-generations general equilibrium framework, uncovering significant dynamic spillovers into non-teaching occupations.

Furthermore, this study extends the literature on the aggregate impacts of reward structures in critical occupations, such as government officials (Murphy et al., 1991; Acemoglu, 1995) entrepreneurs (King and Levine, 1993; Baumol, 1996), and top earners (Gottlieb et al., 2023). By focusing on teachers—a profession vital to human capital formation—it demonstrates the extensive economic consequences of teacher selection, given their role in shaping future generations' human capital.

The rest of the paper is structured as follows. Section 2 outlines the theoretical model and its core mechanisms. Section 3 describes the calibration approach and results. Section 4 presents the primary counterfactual analyses. Section 5 concludes with key insights and policy implications.

2. Model

This section presents the model setup, the equilibrium definition, and the discussion of model mechanisms.

2.1 Households

The economy is populated by overlapping generations of agents that live for two periods, as children and as adults. Each cohort has the same mass. Following De la Croix and Doepke (2004), only adults make active decisions.

Adult agents differ by human capital h. They choose occupations o, working effort l, and consumption c to solve the recursive utility maximization problem

$$V(h) = \max_{o,l,c} \ \log(c) - \mu \cdot \frac{l^{1+1/\nu}}{1+1/\nu} + \delta \cdot \mathbb{E}_\epsilon V(h') \tag{1}$$

subject to the budget constraint

$$c = y_o(h,l) \cdot (1-\tau), \tag{2}$$

the income schedule of each occupation

$$y_o(h,l) = \begin{cases} \beta_\mathcal{W} + w_\mathcal{W} \cdot h \cdot l & o = \mathcal{W} \\ \beta_\mathcal{T} + w_\mathcal{T} \cdot h \cdot l & o = \mathcal{T} \end{cases}, \tag{3}$$

the child human capital production function

$$h' = \epsilon \cdot h^\rho \cdot e^\gamma, \qquad \log(\epsilon) \sim \mathcal{N}(-\sigma_\epsilon^2/2, \sigma_\epsilon^2), \tag{4}$$

and the teaching resource allocation rule

$$e = p \cdot (y_o(h,l) \cdot \tau)^\eta, \tag{5}$$

In the objective function (1), the instantaneous payoff is composed of the utility from consumption $\log(c)$ and the disutility from exerting effort $\mu \cdot \frac{l^{1+1/\nu}}{1+1/\nu}$ where parameter μ governs the level of disutility and ν determines the effort supply elasticity with respect to wages. Agents also receive altruistic utility $\delta \cdot \mathbb{E}_\epsilon V(h')$ where δ determines the degree of altruism, h' is children's human capital, and ϵ is the ability shock that children receive when they enter adulthood.

As shown in the budget constraint (2), agents consume the labor income $y_o(h,l)$ after paying linear labor taxes at the rate τ. Agents can choose to become workers $o = \mathcal{W}$ or to become teachers $o = \mathcal{T}$. The income schedule in each occupation is a function of human capital h and effort l, shown in Equation (3). As can be seen, each occupation pays a base income β_o compensating for agents' labor input and additional income $w_o hl$ that is linear in the product of human capital and efforts supplied.[1]

Children's human capital h' is generated in the production function (4) where parental human capital spillover is governed by parameter ρ, the lognormal distribution of ability shock has variance σ_ϵ^2, and parameter γ determines the elasticity of child human capital to teaching resource input at the household level.

Lastly, I assume that the amount of teaching resource e, i.e., teachers' human capital input, is a function of the tax contribution of each household $y_o(h,l)\tau$. This assumption is motivated by Zheng and Graham (2022) who show that local property tax revenues finance more than half of the public school expenditures in the United States. Parameter $\eta > 0$ governs the progressivity of the teaching resource distribution, where higher (lower) η implies a more regressive (progressive) system. In Equation (5), p is an endogenous object that maps household tax contributions to the amount of teaching resource e received, and hence can be regarded as the shadow price of teachers' human capital input.

There are two points worth noting about the household problem. First, because chil-

[1] I adopt the current formulation of income schedule because in this setup, reductions in $w_\mathcal{T}$ unambiguously dampens teachers' effort, consistent with the quasi-experimental evidence from Hoxby (1996) and Biasi (2021). If instead I multiply effort l with both β and $w \cdot h$, then the effect of $w_\mathcal{T}$ on teachers' effort is ambiguous because the base wage $\beta_\mathcal{T}$ is a general equilibrium outcome.

dren's human capital h' depends on teacher input e, and e depends on household tax contribution $y \cdot \tau$, altruistic parents internalize the fact that higher income results in higher (expected) children's human capital and adjust their occupation and effort decisions accordingly. Second, while agents take prices and the tax rate as given, these objects are equilibrium objects, as will be discussed in Section 2.4 with more details.

2.2 Firms

The firm side of the model is kept simple. A representative firm produces the numeraire consumption good using a constant returns to scale production function that employs labor L and human capital H. The production function is given by

$$C = \left(\lambda \cdot L^{\frac{\phi-1}{\phi}} + (1-\lambda) \cdot H^{\frac{\phi-1}{\phi}}\right)^{\frac{\phi}{\phi-1}} \tag{6}$$

where λ determines the weight of labor and $\phi > 1$ governs the elasticity of substitution between labor and human capital.

2.3 Government

The government uses several policy instruments to regulate the teacher labor market and the education market.

1. The government posts Ω units of teaching jobs in the labor market and use income tax proceedings to finance teachers' wage bill subject to budget balance.

2. The government determines κ_h, the minimum human capital rank that agents need to attain to be eligible to become teachers. That is, if we use $F(h)$ to denote the cumulative density function of the population, only agents with $\tilde{h}$ such that $F(\tilde{h}) \geq \kappa_h$ can choose $o = \mathcal{T}$.[2]

[2]Instead of using rank requirements, another option is to adopt level requirements, e.g., $h \geq \overline{h}$ for some $\overline{h}$. I adopt the rank requirement κ_h for two reasons. First, given that the policy counterfactual are small perturbations around the stationary equilibrium, the two approaches yield similar results. Second

3. The government regulates $w_{\mathcal{T}}$, the return to human capital among teachers. This feature captures the compression of wages in the teaching profession, which is the outcome of the negotiation between the government and the teacher union, often in the form of duty-to-bargain laws (see Biasi (2021)).

4. The government determines η, the elasticity of teaching resource received by each household with respect to the amount of tax contribution. In reality, the policy instrument can be of many different forms, such as income-dependent vouchers, school financing, place-based interventions, school segregation, and so on.

2.4 Equilibrium Definition

Let Θ_o be the set of individuals selecting to be in occupation o, the *stationary competitive equilibrium* of the economy is a set of policy functions and prices that satisfy the following set of conditions.

1. Agents solve the utility maximization problem. The solution gives policy functions $o^*(h), l^*(h)$, and $c^*(h)$, which leads to $y^*(h)$ and $e^*(h)$.

2. Firm chooses factor demand to maximize profits. For both labor and human capital, prices equal to marginal productivity:

$$\beta_{\mathcal{W}} = \frac{\partial C}{\partial L} \qquad w_{\mathcal{W}} = \frac{\partial C}{\partial H} \tag{7}$$

3. Worker labor market clears:

$$L = \int_{\Theta_{\mathcal{W}}} dF(h) \qquad H = \int_{\Theta_{\mathcal{W}}} l^*(h) \cdot h \, dF(h) \tag{8}$$

and more importantly, the rank requirement fits better in both cross-section and historical settings. For example, a college degree may not be a necessary condition to become teachers in many developing countries where workers with a college degree are harder to find.

4. Teacher labor market clears:

$$\Omega = \int_{\Theta_{\mathcal{T}}} dF(h) \tag{9}$$

$$\underbrace{\int p \cdot (y^*(h))^{1-\eta}\, dF(h)}_{\text{teachers' human capital received by households}} = \underbrace{\int_{\Theta_{\mathcal{T}}} l^*(h) \cdot h\, dF(h)}_{\text{teachers' human capital supplied}} \tag{10}$$

5. Consumption goods market clears:

$$\int c^*(h)\, dF(h) = C \tag{11}$$

6. Government budget clears:

$$\int_{\Theta_{\mathcal{T}}} y^*(h)\, dF(h) = \int \tau \cdot y^*(h)\, dF(h) \tag{12}$$

7. Human capital distribution is stationary:

$$F(h_k) = \iint \mathbb{1}\left(\epsilon \cdot h^{\rho} \cdot (e^*(h))^{\gamma} < h_k\right)\, d\mathcal{N}(\epsilon)\, dF(h) \tag{13}$$

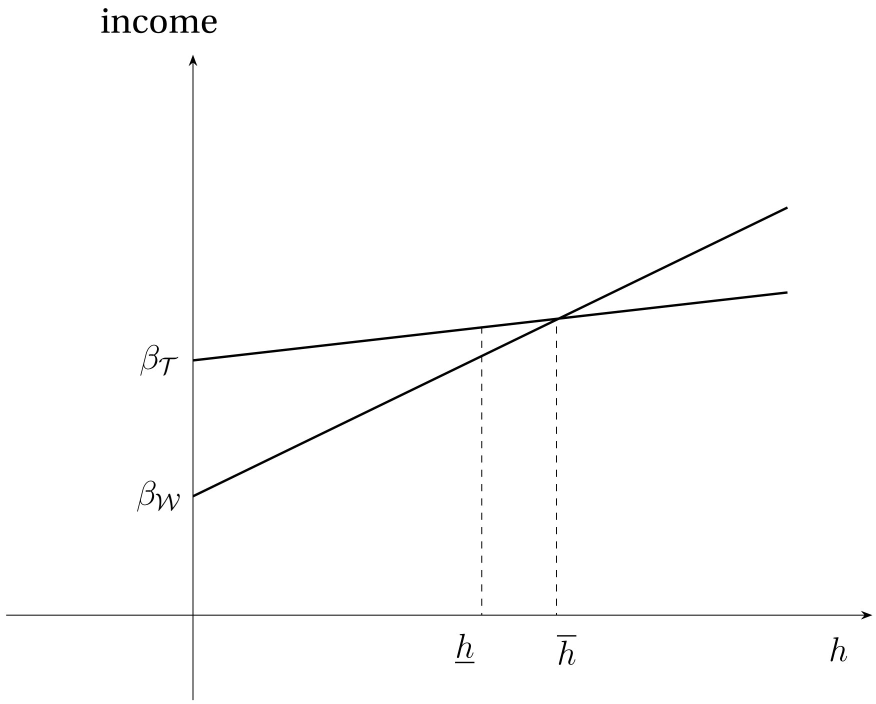
2.5 Equilibrium Characterization

Assuming that $w_{\mathcal{T}} < w_{\mathcal{W}}$, a condition empirically verified in the data (see Section 3 and Appendix B), Figure 1 illustrates the occupational choices of agents in the competitive equilibrium.

Specifically, the set of individuals opting to become teachers is given by $\Theta_{\mathcal{T}} = [\underline{h}, \overline{h}]$. Agents with human capital $h < \underline{h}$ would earn higher income as teachers but fail to meet the human capital rank requirement $F(h) < \kappa_h$, and thus become workers. Conversely, agents with $h > \overline{h}$ choose to be workers due to the relatively low teacher wage.[3] The

[3] An alternative approach that allows for more dispersion of human capital within the teaching profession is to add idiosyncratic (Logit) shocks in the occupation choice problem. In that case, agents with $h \geq \overline{h}$ will all have positive probabilities to become teachers, with the probability being larger for agents with human capital closer to $\underline{h}$ given that $w_{\mathcal{T}} < w_{\mathcal{W}}$. I omit such shocks to make the model more tractable, in line with other general equilibrium models with occupation choices, such as Lee and Shin (2017) and

Figure 1: Occupation choice characterization



bounds $\underline{h}$ and $\overline{h}$ satisfy three conditions:

1. $F(\underline{h}) = \kappa_h$, the rank requirement for teachers;

2. $F(\overline{h}) - F(\underline{h}) = \Omega$, the number of teacher positions set by the government;

3. Income equivalence between occupations at $\overline{h}$, given by

$$\beta_{\mathcal{T}} + w_{\mathcal{T}} \cdot \overline{h} \cdot l^*(\overline{h}) = \beta_{\mathcal{W}} + w_{\mathcal{W}} \cdot \overline{h} \cdot l^*(\overline{h}).$$

The intercepts and slopes in Figure 1 represent equilibrium prices that ensure labor market clearing. For a detailed discussion of the numerical algorithm used to compute the stationary equilibrium, see Appendix A.

Danieli (2024).

2.6 Mechanisms

In this section, I outline the model's mechanisms and highlight the critical role of general equilibrium responses in prices and human capital distribution.

Consider a scenario where the supply of teachers' human capital declines. This reduction triggers several interconnected effects:

1. **Impact on the skill premium**

   Teachers are essential for developing children's human capital. A decrease in teachers' human capital reduces the next generation's human capital. In general equilibrium, this scarcity increases the skill premium–the *price* of human capital among workers–to balance the market. Since individuals born to parents with higher human capital tend to inherit higher human capital, the rising skill premium disproportionately benefits them, increasing both intergenerational income persistence and cross-sectional inequality

2. **Shifts in human capital distribution**

   Beyond price changes, a reduction in teachers' human capital alters the population's human capital distribution, i.e., *quantity* of human capital across households. Altruistic parents respond to scarcer teaching resources by intensifying their labor efforts to secure more income and gain an advantage in the competition for educational resources. However, the returns to these efforts vary, depending on parents' human capital and the elasticity of educational resources relative to tax contributions. If wealthier parents have a competitive edge, the decline in teachers' human capital leads to a more unequal human capital distribution in the next generation.

3. **Compounding effect of teacher quality**

   Teachers are drawn from the broader population, so a decline in teachers' human capital perpetuates over time. This *dynamic* amplifies the above mechanisms, making one-generation estimates a conservative lower bound for long-term impacts.

4. **Cause of the decline matters**

   The reason behind the fall in teachers' human capital influences outcomes. For instance, if driven by fewer teaching positions or lower qualification standards, high-human-capital individuals may shift to other professions. This shift requires contemporaneous factor price adjustments to absorb the increased labor supply, creating a static crowding out effect distinct from the dynamic mechanisms above.[4] Consequently, short-run policy evaluations may differ significantly from long-run outcomes. On the other hand, if driven by reductions in teaching effort due to changes in the incentive scheme within the teaching profession, such static crowding out effect is more muted.

To quantify and disentangle these effects, I proceed to calibrate the model in the next section.

3. Calibration

This section outlines the calibration strategy and data sources, and presents the calibrated parameter values.

I calibrate the model to replicate key data moments from the United States around

[4]One caveat is that the magnitude of the crowding out effect will be weaker if teaching skills and human capital as workers are imperfectly correlated, e.g., in a Roy (1951) model. Existing estimates of the correlation is scant. To the best of my knowledge, Tincani (2021) constructs a Roy-type model and estimated it using Chilean data. She finds a mildly negative correlation (-0.1) between teacher skill and non-teacher wage offers for public school teachers, and larger and positive correlation (0.38) for private school teachers. Other empirical papers, such as Corcoran et al. (2004) and Bacolod (2007), find that the rise in employment opportunities for talented women in the United States is responsible for the decline in the quality of the teacher labor force. Theoretical papers, such as Gilpin and Kaganovich (2012) and Artige and Cavenaile (2023), commonly assume perfect correlation for tractability reasons, as we also do in this paper.

2000. The parameters to be calibrated are

$$\underbrace{\delta, \mu, \nu}_{\text{preference}}, \underbrace{\rho, \gamma, \sigma_\epsilon}_{\text{human capital production}}, \underbrace{\eta, \kappa_h, \omega, w_{\mathcal{T}}}_{\text{government}}, \underbrace{\lambda, \phi}_{\text{goods production}}$$

Other model objects, including $F(h), p, \tau, \beta_{\mathcal{T}}, \beta_{\mathcal{W}}, w_{\mathcal{W}}$ are endogenous outcomes pinned down in the general equilibrium.

Several parameters are directly sourced from the literature. Parental altruism toward children, δ, is fixed at 0.34 following Daruich (2018). The labor supply elasticity, ν, is set to 1/3, following Keane (2011). The direct parental human capital spillover to children, ρ, is set to 0.27, based on Lefgren et al. (2012). The elasticity of substitution between labor and human capital in goods production, ϕ, is chosen to be 3, a mid-point between the estimates from Katz and Murphy (1992) and Bils et al. (2024).

The rest of the parameters are calibrated to match the data moments. Although all parameters jointly influence the moments, certain moments provide stronger identification for specific parameters. Below, I outline the identification logic:

- The disutility of effort, denoted by μ, is inferred from the average hours worked by individuals in the labor force, using data from the Current Population Survey Annual Social and Economic Supplements (CPS-ASEC). Since the relationship between effort and hours worked may not be one-to-one, I explored various values of μ. The shape of the value function and the primary findings of the study remain largely unaffected by these variations.

- The elasticity of child human capital with respect to teacher input, denoted by γ, is calibrated to match the estimated impact of teacher value-added on students' adult income, as reported by Chetty et al. (2014a). Specifically, Chetty et al. (2014a) find that a one-standard-deviation increase in teacher quality for a single grade increases annual earnings by 1.3%. To account for twelve years of compulsory schooling, this estimate is multiplied by 12. On the model side, I first solve for the distribution of teacher input, $e^*(h)$, and compute its standard deviation. I then calculate the effect of providing the median child with additional teacher input equivalent to one standard deviation. Thus, γ is calibrated using an indirect inference approach.

- The standard deviation of the ability shock, σ_ϵ, is calibrated to match the Gini coefficient of earnings from the Current Population Survey Annual Social and Economic Supplements (CPS-ASEC). A larger σ_ϵ increases human capital dispersion, resulting in a higher Gini coefficient.

- The elasticity of teaching resources with respect to parental tax contributions, η, is calibrated to align with intergenerational mobility statistics from Chetty et al. (2014b). Specifically, η is chosen to target an absolute upward mobility of 0.42, defined as the expected income rank of a child whose parents are at the 25th percentile of the income distribution. A larger η amplifies educational inequality, leading to greater income persistence.

- The human capital rank requirement for teachers, κ_h, is set to match the 25th percentile of teachers' Armed Forces Qualification Test (AFQT) scores in the general population, using data from the National Longitudinal Survey of Youth (NLSY).

- The number of teaching positions, Ω, is inferred from the proportion of teachers in the labor force, based on CPS-ASEC data. Teachers are identified as occupations with OCC90LY codes between 155 and 163.

- The returns to human capital for teachers, $w_{\mathcal{T}}$, are calibrated to reflect the relative returns to human capital between teachers and non-teachers. Using NLSY data, I regress hourly wages on AFQT scores for both groups and compare the coefficients. The ratio of the coefficients is approximately 0.75, indicating wage compression in the teaching profession. In Appendix B, I presents a more detailed discussion of this data moment.

- The weight of labor in goods production, λ, is calibrated to match the 90-10 income ratio reported by Heathcote et al. (2023). An increase in λ reduces the skill premium, lowering the 90-10 income ratio, as agents with higher human capital are more affected by a decline in the price of human capital.

Table 1 displays the calibrated parameters alongside the corresponding data moments. Given that the model is just identified, it exactly matches all the target moments. Furthermore, the model also performs well in some key non-targeted moments. In particular, the model predicts differential responsiveness of child human capital to changes in teaching resources that is in line with the quasi-experimental evidence from Lovenheim and Willén (2019) and Lavy (2020). I will elaborate on this point in Section 4.2.

4. Policy Counterfactual

In this section, I conduct four counterfactual experiments where the government uses different policy instruments at hand to affect the teacher labor market and the education market. For each case, we compare the results from the long-run general equilibrium, fixing the human capital distribution, and one-generation estimates. The comparison serves to highlight the importance of considering general equilibrium effects originating from endogenous prices and human capital distribution.

4.1 Distribution of Teaching Resources

In the first policy counterfactual, I make the distribution of teaching resources more equitable by lowering η from 2.5 to 2, a 20% reduction. Because η governs the elasticity of teacher resource received with respect to parental tax contribution, a smaller η redistributes teaching resources from rich to poor families. In reality, such policies can take many different forms and have been studied extensively, such as school financing (Fernandez and Rogerson (2003), Zheng and Graham (2022)), place-based interventions (Chyn and Daruich (2022)), school segregation (Park and Hahm (2023)), and so on.

Table 1: Calibration results

	Parameter	Value	Data moment	Source	Model fit
δ	Altruism	0.34		Daruich (2018)	
μ	Effort disutility	25	Average hours = 0.3	CPS-ASEC	0.3
ν	Frisch labor supply elasticity	0.33		Keane (2011)	
ρ	Parental h.c. transmission	0.27		Lefgren et al. (2012)	
γ	Teacher value added	0.11	1 std TVA $\Rightarrow$ 1.3% in y_k	Chetty et al. (2014a)	1.3%
σ_ϵ	Ability shock dispersion	2.3	$\text{Gini}_y = 0.42$	CPS-ASEC	0.42
η	Distribution of teaching resources	2.5	$\text{rank}_k^{0.25} = 0.42$	Chetty et al. (2014b)	0.42
κ_h	Teacher qualification requirement	0.6	AFQT rank of teachers = 0.6	NLSY	0.6
Ω	Number of teachers	0.04	Teacher share = 0.04	CPS-ASEC	0.04
w_T	Returns to h.c. among teachers	2.5	Relative returns in AFQT = 0.75	NLSY	0.75
λ	Labor weight in goods production	0.94	90/10 income ratio ≈ 9	Heathcote et al. (2023)	9.0
ϕ	Substitutability in good production	3.0		Katz and Murphy (1992) and Bils et al. (2024)	

Table 2: More equitable distribution of teaching resources

Changes relative to baseline	Long-run GE	Fix $F(h)$	Next gen
Aggregate teaching resource	7.73%	-0.78%	4.00%
Price of teaching resource	-33.50%	-25.63%	-29.57%
Average human capital	6.07%	0.00%	2.66%
Average worker effort	-1.21%	0.12%	-0.11%
Aggregate output	0.19%	0.00%	0.07%
Skill premium	-8.14%	1.04%	-2.58%
Gini coefficient (income)	-4.53%	0.63%	-1.59%
90-10 income ratio	-6.70%	1.49%	-1.48%
90-10 human capital ratio	-5.05%	0.00%	-4.92%
$\mathbb{E}_\epsilon(h')$ from 10th parent	10.36%	8.24%	8.24%
$\mathbb{E}_\epsilon(h')$ from 90th parent	-1.35%	-0.64%	-0.64%

Table 2 presents the results across three scenarios: (1) long-run general equilibrium, (2) fixed human capital distribution, and (3) next generation.

In the long-run general equilibrium, a more equitable allocation of teaching resources significantly increases average human capital by 6.1%. Consequently, the skill premium—the price of human capital among workers—decreases by 8.1%, reflecting diminished marginal productivity. Moreover, as teachers are drawn from the general population, aggregate teaching resources rise by 7.7%. The increased availability of teaching resources, combined with lower sensitivity of teacher input to tax contributions, reduces the shadow price of teaching resources by one-third, indicating reduced competition in the education market.

Regarding inequality, the Gini coefficient of income declines by 4.5%, driven by two factors. First, the 90–10 human capital gap narrows by 3.3%. Second, the reduction in the skill premium further mitigates income inequality, resulting in a 90–10 income gap reduction nearly twice as large as that of the human capital gap alone. This disparity underscores the importance of accounting for general equilibrium price dynamics in policy evaluation. Additionally, children of parents at the 10th percentile of human capital experience an expected human capital gain exceeding 10%, while those of parents at the 90th percentile face a 1.4% reduction, highlighting the policy's redistributive impact.

The second scenario emphasizes the role of endogenous human capital distribution. When human capital distribution is held fixed, all gains in aggregate teaching resources and average human capital disappear. Instead, the Gini coefficient and 90–10 income ratio increase, reversing the inequality reductions observed in the long-run general equilibrium case.

Finally, the next-generation analysis reveals differences between short-run and long-run policy impacts. Compared to the long-run general equilibrium, changes in all variables are smaller in absolute value in the next generation. For instance, average human capital rises by 6.1% in the long run but only by 2.7% in the next generation. This difference arises because improved education outcomes for children translate into better parental inputs in subsequent generations, amplifying the benefits of educational investments over time, as noted in Daruich (2018).

4.2 Returns to Human Capital Among Teachers

In the second policy counterfactual, I reduce the returns to human capital among teachers by 20%, from 2.5 to 2. In reality, this mimics one important outcome of collective bargaining and duty-to-bargain laws – the compression of pay scales (Hoxby and Leigh (2004), Biasi (2021)).

Table 3 presents the outcomes under three scenarios: (1) long-run general equilibrium, (2) fixed human capital distribution, and (3) next generation.

In the long-run general equilibrium, teacher wage compression reduces aggregate teaching resources by approximately 10% and aggregate human capital by about 1%. Compared to the previous case, the change in human capital is less pronounced because the reduction in teaching resources is not inherently redistributive. The skill pre-

Table 3: Lowering returns to human capital among teachers

Changes relative to baseline	Long-run GE	Fix $F(h)$	Next gen
Aggregate teaching resource	-9.67%	-7.97%	-9.65%
Price of teaching resource	5.53%	4.89%	5.76%
Average human capital	-0.97%	0.00%	-0.79%
Average worker effort	0.33%	0.26%	0.39%
Aggregate output	0.00%	0.00%	0.00%
Skill premium	1.48%	0.56%	1.50%
Gini coefficient (income)	0.90%	0.67%	1.03%
90-10 income ratio	0.77%	1.12%	1.61%
90-10 human capital ratio	-1.53%	0.00%	-0.76%
$\mathbb{E}_\epsilon(h')$ from 10th parent	-0.86%	-0.70%	-0.70%
$\mathbb{E}_\epsilon(h')$ from 90th parent	-0.28%	-0.39%	-0.39%

mium increases as aggregate human capital declines. Additionally, the shadow price of teaching resources rises by 5.5%, indicating heightened competition for scarcer teaching resources.

On inequality, the Gini coefficient increases by 0.9%, and the 90–10 income ratio rises by 0.8%. However, the 90–10 human capital ratio in the new stationary distribution decreases by 1.53%, reflecting a downward-shifted and more compressed human capital distribution. Notably, children of parents with lower human capital experience a larger reduction in expected human capital, as these families face greater challenges in competing for limited teaching resources. This finding aligns with the quasi-experimental evidence in Lovenheim and Willén (2019). Using Census micro-level data from the United States, Lovenheim and Willén (2019) show that Black and Hispanic students, often from lower-income households, experience greater long-term adverse effects, such as in education, employment, hours, and earnings, from childhood exposure to teachers' collective bargaining agreements compared to White students. Similar heterogeneous treatment effects are also found by Lavy (2020) when he examines the long-term impacts of teachers' pay-for-performance experiment conducted in Israel. Specifically, Lavy (2020) finds larger positive effects for children with parents below the median income.

Compared to the long-run general equilibrium, the fixed human capital distribution and next-generation scenarios yield qualitatively similar results. A key quantitative difference is the magnified disparate impact of teacher wage compression on children's human capital across income groups in the long run. Specifically, the ratio of human capital loss for children of parents at the 10th percentile versus the 90th percentile is 1.8 in the next generation but rises to 3.1 in the long run. Consequently, for policymakers focused on economic mobility, relying solely on next-generation results significantly underestimates the adverse long-term effects of teacher wage compression.

4.3 Teacher Qualification Requirement

In the third policy counterfactual, I increase the teacher qualification requirement, i.e., the rank threshold for teachers, from 0.6 to 0.65. To fulfill the same number of teacher job postings with agents with better outside options, the government needs to raise the base wage β_T and hence the tax rate. In reality, this mimics a rise in education or licensing requirements (Wiswall (2007)).

Table 4 presents the outcomes under three scenarios: (1) long-run general equilibrium, (2) fixed human capital distribution, and (3) next generation.

In the long-run general equilibrium, increasing the human capital requirement for teachers significantly boosts aggregate teaching resources by 18.6%, despite the number of teachers remaining constant. This increase in teaching resources reduces their shadow price by 9.4% and raises average human capital by 1.6%. Similar to the previous counterfactual, the change in average human capital is modest because the policy does not specifically target low-income households. The rise in human capital leads to a decline in the skill premium. However, aggregate output increases only marginally by

Table 4: Raising teacher qualification requirement

Changes relative to baseline	Long-run GE	Fix $F(h)$	Next gen
Aggregate teaching resource	18.59%	15.92%	17.38%
Price of teaching resource	-9.37%	-6.02%	-6.12%
Average human capital	1.64%	0.00%	0.50%
Average worker effort	-0.12%	0.70%	0.68%
Aggregate output	0.19%	0.19%	0.14%
Skill premium	-1.51%	1.54%	1.14%
Gini coefficient (income)	-0.89%	0.71%	0.91%
90-10 income ratio	-1.11%	2.73%	3.13%
90-10 human capital ratio	-2.49%	0.00%	0.76%
$\mathbb{E}_{\epsilon}(h')$ from 10th parent	1.29%	0.34%	0.34%
$\mathbb{E}_{\epsilon}(h')$ from 90th parent	0.70%	1.09%	1.09%

0.2% in the long run, despite the 1.6% rise in average human capital. This is due to a crowding out effect, where high-human-capital individuals enter the teaching profession, reducing the human capital available for producing consumption goods.

Regarding inequality, the Gini coefficient decreases by 0.9% in the long run, and the 90–10 income ratio falls by 1.1%. Children of parents at the 10th percentile of the human capital distribution experience a larger increase in expected human capital compared to those of parents at the 90th percentile, indicating enhanced intergenerational mobility.

However, the results differ when fixing the human capital distribution or examining next-generation outcomes. Due to the crowding out mechanism, the one-generation increase in average human capital is insufficient, or entirely absent when the human capital distribution $F(h)$ is fixed, to offset the loss of high-quality workers to the teaching profession. Consequently, the skill premium rises to clear labor markets. Since high-human-capital individuals benefit more from the increased skill premium, the 90–10 income ratio rises by approximately 3%. Moreover, as teaching resource allocation depends on tax contributions, children of wealthier parents experience greater increases in human capital than those of poorer parents—a result that contrasts with the long-run general equilibrium. This counterintuitive outcome highlights the critical need to account for endogenous factor prices and human capital distribution in policy analysis.

4.4 Number of Teachers

In the final policy counterfactual, I raise the proportion of teachers in the labor force from 4% to 5%. Unlike the previous counterfactual, where increased teaching resources stemmed from enhanced teacher human capital, this scenario drives the increase through a higher number of teachers. In reality, such policies can take the form of mandating maximum class size (Browning and Heinesen (2007), Chingos and Whitehurst (2011)).

Table 5: Larger number of teachers

Changes relative to baseline	Long-run GE	Fix $F(h)$	Next gen
Aggregate teaching resource	19.08%	17.65%	17.72%
Price of teaching resource	-10.65%	-8.20%	-8.02%
Average human capital	1.64%	0.00%	0.61%
Average worker effort	-0.35%	0.29%	0.24%
Aggregate output	-0.75%	-0.81%	-0.80%
Skill premium	-2.61%	0.26%	-0.46%
Gini coefficient (income)	-0.54%	0.84%	0.82%
90-10 income ratio	-2.50%	0.74%	0.79%
90-10 human capital ratio	-2.49%	0.00%	0.76%
$\mathbb{E}_\epsilon(h')$ from 10th parent	1.58%	0.79%	0.79%
$\mathbb{E}_\epsilon(h')$ from 90th parent	0.62%	0.99%	0.99%

Table 5 presents the outcomes of increasing the share of teachers from 4% to 5% under three scenarios: (1) long-run general equilibrium, (2) fixed human capital distribution, and (3) next generation.

In the long-run general equilibrium, raising the teacher share significantly increases aggregate teaching resources by 19.08%, as more individuals are allocated to teaching. This expansion reduces the shadow price of teaching resources by 10.65%, reflecting diminished competition for these resources. Average human capital rises by 1.64%, driven by the increased availability of teaching resources. However, aggregate output declines by 0.75%, as the shift of workers into teaching reduces the labor supply for producing consumption goods. The skill premium falls by 2.61%, consistent with the rise in human capital. Average worker effort decreases slightly by 0.35%, likely due to less intensive labor market competition.

Regarding inequality, the Gini coefficient for income decreases by 0.54%, and the 90–10 income ratio falls by 2.50% in the long run. The 90–10 human capital ratio also declines by 2.49%, indicating a more compressed human capital distribution. Children of parents at the 10th percentile of the human capital distribution experience a 1.58% increase in expected human capital, compared to a 0.62% increase for children of parents at the 90th percentile, suggesting improved intergenerational mobility due to the policy's broad enhancement of teaching resources.

In contrast, the results diverge when the human capital distribution $F(h)$ is fixed or when examining next-generation outcomes. When $F(h)$ is held constant, the skill premium rises because individuals ranked between the 69th and 70th percentiles of human capital now enter the teaching profession, reducing the relative supply of human capital in other sectors. This increase in the skill premium leads to a higher 90–10 income ratio. Consequently, children of parents at the 90th percentile of human capital experience greater gains in expected human capital compared to those of parents at the 10th percentile. In the next-generation scenario, a general rise in human capital partially offsets the crowding out effect, leading to a decline in the skill premium. However, the initial advantage for wealthier families persists, resulting in sustained increases in inequality and the 90–10 income ratio relative to the baseline.

Consistent with the previous counterfactual, these findings highlight the critical role of endogenous skill premiums and human capital distribution in policy evaluation. In the long run, increasing the number of teachers enhances human capital and reduces inequality. However, one-generation or fixed-distribution analyses reveal adverse effects on output and inequality, driven by labor market crowding out and constrained human capital responses.

5. Conclusion

This paper develops a general-equilibrium overlapping generations (GE-OLG) model with occupation choice and child human capital formation to analyze the impacts of teachers on income inequality. Calibrated to U.S. data, the model matches the cross-sectional moments as well as micro-level evidence from papers like Lovenheim and Willén (2019) and Lavy (2020).

Using the model, I show that declining teachers' human capital amplifies inequality through three channels: rising skill premium due to reduced human capital supply, heightened competition for scarce teaching resources, and a compounding decline in teacher quality over generations.

When I use the calibrated model to evaluate policy counterfactuals, I find that policies enhancing teacher quality or availability, such as more equitable distribution of teaching resources, raising human capital standards, or expanding the number of teachers, significantly reduce long-run income inequality by elevating aggregate human capital and lowering the skill premium. In contrast, policies like teacher wage compression intensify inequality by constraining teaching resources, disproportionately hindering human capital accumulation for children from lower-income households.

Importantly, I further demonstrate the critical role of general equilibrium effects and endogenous human capital distribution in policy evaluation. One-generation or fixed-distribution analyses often obscure the long-run benefits of education policies, as seen in the teacher share counterfactual, where long-run inequality falls but short-run inequality rises due to labor market crowding out and the slow-moving nature of the human capital distribution. The findings call for a micro-to-macro approach to policy analysis and design.

One promising direction for future research is to incorporate additional parental responses to teacher resource changes into the framework, such as migration (Zheng and Graham (2022)), voting for policy regimes (Kotera and Seshadri (2017)), or through private money and time investments (Daruich (2018)).

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A. Computation Algorithm

I find the stationary equilibrium of the model using the following steps:

1. Guess $F(h)$, $\beta_{\mathcal{W}}$, $w_{\mathcal{W}}$, $\beta_{\mathcal{T}}$, τ, and p.

2. Knowing κ_h and Ω, I can pin down $\Theta_{\mathcal{T}} = [\underline{h}, \overline{h}]$.

3. Solve the value function iteration problem. This gives $o^*(h), l^*(h), y^*(h), c^*(h), e^*(h)$.

4. Find new $F(h)$, $\beta_{\mathcal{W}}$, $w_{\mathcal{W}}$, and p in the following steps:

   (a) $\beta_{\mathcal{T}}$ can be backed out by income equivalence at $h = \overline{h}$.

   (b) $\tilde{F}(h)$ coming from applying the human capital production function.

   (c) $\tilde{\beta}_{\mathcal{W}}$ and $\tilde{w}_{\mathcal{W}}$ comes from the firm's first-order condition and zero profit condition.

   (d) $\tilde{p}$ comes from teaching resource clearing condition.

   (e) Compute τ to balance the government's budget constraint.

5. Iterate and find stationary $F(h)$, $\beta_{\mathcal{W}}$, $w_{\mathcal{W}}$, τ, and p.

B. Relative Returns to Human Capital

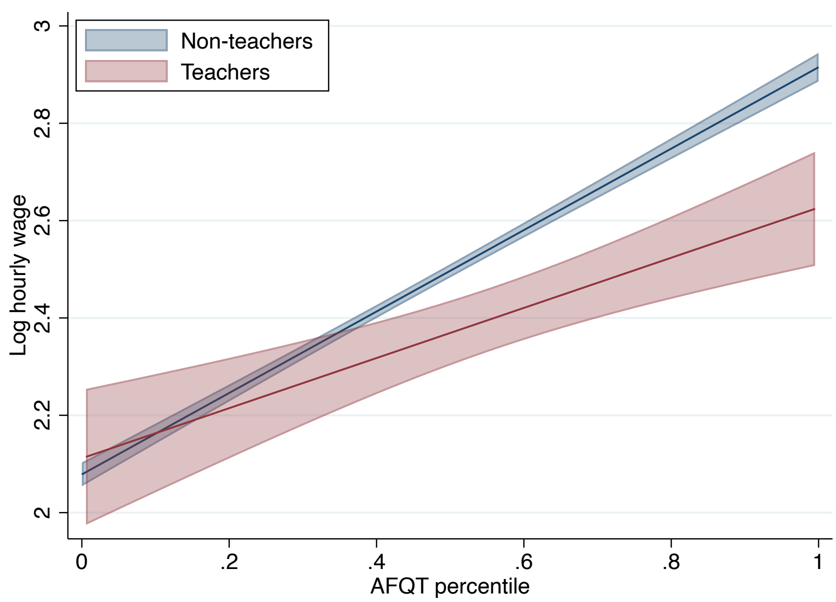
In this section, I compare the returns to human capital in teaching and non-teaching professions by regressing wage on measures of cognitive ability using the Armed Forces Qualification Test (AFQT) percentile score from the National Longitudinal Study of Youth 1979 (NLSY79) data.

The NLSY79 survey tracks a cohort of individuals aged 14 to 22 when they were initially interviewed in 1979. The survey collects their labor market history, including weeks worked, occupation codes, and hourly wages. For each individual, their cognitive ability was assessed in 1980 through ten intelligence tests known as the Armed

Services Vocational Aptitude Battery (ASVAB), and a summarizing measure known as the Armed Forces Qualification Test (AFQT) percentile score was computed. With some caveats, the AFQT score was a commonly used measure of cognitive skills in the literature (e.g., Neal and Johnson 1996). I restrict the sample to college-educated individuals who worked at least 30 weeks on the primary job last year with an hourly wage of at least one dollar.

Figure 2 plots the relationship between the AFQT score and the hourly wage of individuals in the data. As can be seen, for both teachers and non-teachers, the hourly wage is positively correlated with the AFQT score, but the correlation is stronger among non-teachers.

Figure 2: Relationship between the AFQT Score and Hourly Wage



Notes: This figure plots the relationship between the AFQT percentile score and log hourly wage in year 1996 across occupations for individuals in the NLSY79 sample. The line plots the best linear fitted value. The shaded area plots the 90% confidence interval around the fitted value.

To show this pattern more systematically, I run the following regressions:

$$Y_{i,t} = \alpha_{j,t} + \Psi_{j,t} \cdot \text{AFQT}_i + \varepsilon_{i,t} \tag{14}$$

where i indexes individuals, $j \in \{1, 2\}$ indexes teachers and non-teachers respectively, t represents survey year, and $Y_{i,t}$ is the log of hourly wage. I use the notation $\Psi_{j,t}$ because the independent variable AFQT$_i$ denotes skill percentiles instead of skill levels, hence the interpretation of the coefficient is a little different from the occupation-specific skill bias $\psi_{j,t}$ in the model.

Table 6: Regression Results

	$t = 1996$		$t = 2006$	
	$j = 1$	$j = 2$	$j = 1$	$j = 2$
$\Psi_{j,t}$	0.515	0.837	0.827	0.927
	(0.113)	(0.024)	(0.122)	(0.029)
# Observations	240	2490	227	2193

Notes: This table displays the results of regression (14). Subscript $j \in \{1, 2\}$ indexes teachers and non-teachers respectively. Standard errors in parentheses.

Table 6 reports the regression results. As can be seen, AFQT percentiles are strongly correlated with hourly wage. For example, a one percentile increase in the ranking of AFQT score is correlated with a 0.515% higher hourly wage. Importantly, the regression results suggest that the coefficient is larger in non-teaching occupations ($j = 2$) than that among teacher ($j = 1$). Across the two waves of data, the ratio $\Psi_{1,t}/\Psi_{2,t}$ is on average 0.754.