Relative deprivation and Hey and Lambert's motivation: mixed methods evidence from Rio de Janeiro

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Abstract

Hey and Lambert (1980) provided an interpretation of indices of relative deprivation in terms of interpersonal comparisons: the indices would quantify harmful feelings of frustration, inadequacy and inferiority arising from looking upward to better off others. A growing body of literature has followed this interpretation in quantitative studies which indeed typically reveal a negative association between relative deprivation and social outcomes such as happiness, health or education. However, evidence able to directly link a negative coefficient of relative deprivation to the mechanisms deflating and harmful for the self which underlie Hey and Lambert's interpretation is lacking. We fill this gap by conducting a mixed method study. Using data from three waves of Brazilian high-stake secondary education exams for the state of Rio de Janeiro (N=245,555), we first analyse exam scores in econometric models where absolute income and relative deprivation are jointly employed as explanatory variables. Next, we interpret and expand upon our quantitative results using primary data collected via semi-structured interviews and focus group discussions with 30 local secondary school teachers. In conformity with Hey and Lambert's interpretation, we find robust negative coefficients for relative deprivation, which teachers explain reporting the detrimental effects lower socioeconomic status and upward comparisons have on pupils' self-esteem, motivation and aspirations.

Keywords: Relative Deprivation, Upward Comparisons, Inequality, Education.

1. Introduction

Describing economic inequality, as well as explaining its causes and consequences, has been at the heart of economics since the first steps moved by the discipline. In order to monitor the changes in inequality over time, portray regional differences and study causes and effects of economic inequality, the availability of sound measures able to quantify the phenomenon is essential. Over time, an army of scholars has engaged with the development of measures able to assess economic inequality – providing researchers interested in the study of the haves and have-nots with a formidable array of tools (Lambert 2002, Cowell 2011). In order to account for multiple aspects and conceptualizations of economic inequality, different approaches to measurement have been followed and different indices have been developed. A key element for the soundness of a measurement tool is the conceptualization of the human condition it is expected to quantify – i.e. the motivation behind its use.

This paper focuses on one specific approach to the study of economic inequality, namely the use of individual-level indices meant to quantify individual disadvantages (or advantages) relative to others in society. While inequality in its most fundamental understanding is an aggregate concept representing the extent of economic disparities in a group of individuals, measures of relative deprivation and relative satisfaction[1] portray at an individual level the way inequality impinges on individuals located at different points along the economic ladder. Our aim is to employ relative deprivation as an explanatory variable in customary quantitative analysis, and seek insights which may further our understanding of the way such variable can be interpreted.

More specifically, this paper investigates the role of relative deprivation as a predictor of educational outcomes. To achieve our objectives, we follow a mixed methods design aiming to produce quantitative evidence and shed light upon it via qualitative methods. We estimate econometric models where both absolute income and relative deprivation are used as predictors for educational achievement. This quantitative analysis is based on secondary data from three waves of the Brazilian high-stake secondary education exams (Exame Nacional do Ensino Médio, ENEM) for the state of Rio de Janeiro (years 2016-18, N=245,555). The qualitative part of our paper uses fieldwork data, which we collected through semi-structured

[1] In this paper we use the expression relative satisfaction in keeping with Yitzhaki (1979) and Hey and Lambert (1980), noting that some scholars replace ‘satisfaction’ with other terms such as ‘elation’ and ‘advantage’.

interviews and focus group discussions with 30 secondary school teachers in Rio de Janeiro. In this way, our paper also responds to the need for qualitative methods and methodological pluralism in the study of relative deprivation, which is strongly emphasised in Power, Madsen and Morton's (2020) cross-disciplinary review.

Our quantitative results highlight the independent and significant role of relative deprivation as a negative predictor of educational achievement. The qualitative data support an interpretation of relative deprivation as capturing the detrimental effects of lower socioeconomic status and comparison with better-off individuals. Building upon their everyday experience in the classroom, our teachers explain at length how a position of lower economic status jeopardises pupils' and parents' self-esteem, motivation and aspirations, with deleterious consequences on academic performance.

The paper develops as follows. In section 2 we outline the importance acquired by the notion of relative income in the economics literature, focussing on relative deprivation and highlighting the Yitzhaki's (1979) and Hey and Lambert's (1980) contributions. Section 3 describes our data and our mixed methods approach. Section 4 presents our quantitative results and section 5 discussed them by building upon our qualitative fieldwork data. Section 6 briefly concludes.

2. Relative income and Hey and Lambert's motivation

The idea that individuals are only concerned with their own achievements (say 'income') has long been a key assumption of the economics discipline, despite key figures of the history of economic thought such as Smith (1776), Marx (1849), Veblen (1899) and Pigou (1932) provided a number of insights around the way other's income affects humans – ranging from their ability to be part of society, their consumption behaviour and the satisfaction they derive from material possessions. It was only around the mid of the past century that the idea of a utility function featuring merely own income was formally challenged. Through his 'relative income hypothesis', Duesenberry (1949) provided a formalization of a utility function where utility was not only positively dependent on own income, but also negatively related to other people's incomes.

The importance of relative income became then gradually acknowledged in the economics literature. Theoretical research adopting a relativistic approach to utility cover a number of areas, including consumer behaviour (Hirsch 1976, Frank 1985, Bagwell and Bernheim 1996

and Hopkins and Kornienko 2004), taxation (Boskin and Sheshinski 1978, Aronsson and Johansson-Stenman (2008, 2010), fertility (Leibenstein 1975), public expenditure (Ng 1987), unemployment (Akerlof and Yellen 1990), economic growth (Cole et al. 1992), savings (Direr 2001), finance (Abel 1990 and Galí 1994), risk (Robson 1992) and redistributive policies (Bilancini and Boncinelli 2012). In addition, the recent paper by Michaillat and Saez (2021) shows how a relativist view of utility can shed light on anomalies in New Keynesian economic models. Empirical research followed suit, with the production of evidence attesting the importance of relative income for subjective wellbeing, life satisfaction and happiness (see the reviews by Clark, Frijters and Shields 2008 and Verme 2018), employment decisions (Neumark and Postlewaite 1998), effort (Clark, Masclet and Villeval 2010), tax preferences (Karadja, Mollerstrom and Seim (2017), educational outcomes (Esposito and Villaseñor 2019) and residential choices (Bottan and Perez-Truglia 2022).

Some studies operationalise relative income as the share of mean income (Layard, 1980, Persson, 1995) or as the distance from mean income (Akerlof, 1997, Corneo and Jeanne, 1997). In this way, the measure of relative income of individual *i* is sensitive to the income distribution both above and below her. A different approach specifies whether the focus lies on the incomes above or below the income of individual *i* – through the concepts of relative deprivation or relative satisfaction, respectively. This approach to the quantification of relative income was first proposed by Yitzhaki (1979), who, building upon the sociological work of Runciman (1966), develops a system of measurement able to quantify relative deprivation and relative satisfaction.

In order to introduce Yitzhaki's indices, let $i = 1,2, \dots N,$ with $N \geq 3,$ denote individuals in society and R_+^n be the set of n-dimensional vectors with non-negative components. The vector $x = (x_1, \dots x_N) \in R_+^n$, indicates a vector of individual incomes in society arranged in increasing order. For $x \in R_+^n$ let the set $B_i(x) = \{j \in n | x_j > x_i\} \in R_+^n$ denote the set of individuals richer than individual $i.$; conversely, let the set, $W_i(x) = \{j \in n | x_j < x_i\} \in R_+^n$ denote the set of individuals poorer individual $i.$ Yitzhaki (1979) indices. These quantify the relative deprivation and relative satisfaction of individual i, $D_i(x)$ and $S_i(x)$, respectively, as follows:

$$D_i(x) = \sum_{j \in B_i(x)} \frac{x_j - x_i}{N} \qquad (1)$$

$$S_i(x) = \sum_{j \in W_i(x)} \frac{x_i - x_j}{N} \quad (2)$$

Importantly, in Yitzhaki's (1979) framework, different income levels represent different bundles of commodities – with the value of each bundle being related to its scarcity. Relative deprivation of individual *i* equates to the overall value of the existing bundles that they are not able to consume, and vice versa for relative satisfaction. Therefore, while the Yitzhaki approach is inspired by the influential sociological work of Runciman, it does not directly rely on individuals comparing themselves to others – nor does its justification enter directly into the utility space (on these aspects of his approach, see also Yitzhaki 1980, 2010). In this sense, the rationale behind Yitzhaki's framework abstracts from the notion that individuals compare their achievements with others', and remains solidly anchored in neoclassical economic theory where utility depends on own income and not on others'.

A change in perspective comes about with the paper by Hey and Lambert (1980), who provide an additional motivation for the system of measurement proposed by Yitzhaki (1979). Runciman's (1966) remark 'The magnitude of a relative deprivation is the extent of the difference between the desired situation and that of the person desiring it' (p. 10) leads Hey and Lambert (1980) to envisage Yitzhaki's (1979) framework as directly quantifying one-to-one interpersonal comparisons of individual achievements. Yitzhaki's indices of relative deprivation (satisfaction) would then compute the implications for individual *i* when she looks upward (downward) at richer (poorer) individuals – and this interpretation would be extended also to subsequently proposed indices. Contrary to Yitzhaki (1979), Hey and Lambert (1980) argue for the relevance of others' incomes for determining individual utility and in this way move beyond neoclassic economic theory.

Hey and Lambert's (1980) motivation revolves around the psychosocial mechanisms occurring when, from a lower position in the economic hierarchy, looking upward at more successful individuals generates a sense of inferiority, frustration and/or envy. This notion of relative deprivation is supported by an impressive body of literature across the social sciences, which over half a century has described in depth the power of such feelings (see the reviews by Smith, Pettigrew and Bialosiewicz 2012, Esposito 2018 and Power, Madsen and Morton 2020). It is therefore not surprising that Hey and Lambert's (1980) motivation underpinned most of the subsequent studies on relative income. These include not only a large number of empirical studies on relative deprivation in the social sciences, but also contributions which introduced nonlinearities in the measurement of relative deprivation

(Paul 1991, Podder 1996, Esposito 2010, Bossert and D'Ambrosio 2014, Stark, Bielawski and Falniowski 2017), as well as a solid body of epidemiological research on the social determinants of health (Wilkinson 1997 and Marmot 2005, amongst others).

What is more surprising is the lack of research which connects large scale empirical evidence on the role of relative deprivation with insights able to shed light on the reasons behind the obtained results. For example, the interpretation of the coefficient obtained for relative income in econometric analyses typically relies on literature attesting the existence of certain feelings and emotions underpinning Hey and Lambert's (1980) motivation. There is little doubt that such psychosocial mechanisms exist, and there is also little doubt that they can stem from being relatively deprived. But do such mechanisms really fit the specific context under study – how can we know this? Scholars working in this area may well recognise this question, whether they have received it from referees or they have asked it as referees themselves. The aim or our paper is to provide such evidence.

3. Methods

3.1 ENEM and our mixed methods approach

ENEM is an annual large-scale high-stakes exam introduced in 1998 by the Brazilian Ministry of Education and managed by the National Institute of Educational Research (INEP) to test the academic competence of high school leavers. The test covers five subjects (writing, maths, humanities, natural sciences and foreign language), is administered over two days and takes place simultaneously across Brazil (Schwartzman and Knobel 2016). From 2009, ENEM scores became the main determinant for admission to public and private universities, making ENEM a crucial vehicle for access to higher education and social mobility. Beyond access to university, ENEM is also an opportunity for participants to obtain an accreditation of their knowledge, which could also be used in the job market. Our aim is to first estimate econometric models where relative deprivation features as explanatory variable (controlling for absolute income) disentangling the specific role played by absolute the relative income. Since we want to both unveil systematic patterns and statistical relationships as well as shed light on the nuances and mechanisms behind them, we combine quantitative and qualitative methods in a mixed methods study.

We frame our approach within the widely used taxonomy for mixed methods research developed by Onwuegbuzie and Collins (2007). We use a *sequential* approach wherein the

qualitative and the quantitative components are not concurrent but take place in different phases – in our case, with the quantitative preceding the qualitative. This choice is linked to the purpose of our research, which fits Onwuegbuzie and Collins's *expansion* category. The main goal of our qualitative phase is not to triangulate, compare or validate results from the quantitative phase, but to elicit perspectives as to the possible social dynamics and processes which may explain the reasons why such patterns were observed. Since it would be difficult to identify nuanced explanations from quantitative secondary data, not least because of the inevitably limited number of available variables, qualitative data are used to shed light on the quantitative results and provide a richer contextualised understanding.

3.2 Quantitative phase

We use data from the 2016, 2017 and 2018 ENEM waves for the state of Rio de Janeiro, (240,340 pupils studying in 2,422 schools). ENEM scores for each participant are calculated by INEP on the basis of item response theory (each question in the exam is weighted according to its difficulty), and each of the 5 subjects is given a score on a 0-1000 scale. Our dependent variable is the simple average of the 5 scores, as this is the metric used by most university programs as admission criterion – weighted averages are employed for specific programs, e.g. for engineering degrees a larger weight is given to the maths score (Cordeiro 2014). We carry out robustness checks using different weights and obtain qualitatively identical results.

Our independent variables of interest are measures of absolute and relative income. We derive our absolute income variable using the information on family income, based on a 17 ordered-categories indicator (1=no income, 2=up to R$880.00, 3=R$880.01-R$1.320.00, etc.). We transform this into a continuous variable by setting income at the midpoint of each category and rescale to 0-1. We choose this simpler approach for clarity and conciseness compared to alternative approaches such as Monte Carlo simulations or imputation by fitting to a distribution (e.g. Banerjee and Piketty 2005). Relative deprivation is computed on the basis of a continuous wealth index developed using polychoric principal component analysis on the basis of information on household assets (Filmer and Pritchett 2001; Kolenikov and Angeles 2009). We develop multiple versions of relative deprivation measures, using linear and nonlinear functional forms (Yitzhaki, 1979; Esposito 2010) as well as different reference groups defined on different combinations based on location (the entire student population or students from the same school), gender and/or race – this enables us to confirm that sign and significance of our results do not depend on the specific characteristic of the relative

deprivation measure used. The results reported in the paper are based on a relative deprivation measure based on pupil's own schools as a reference group, whose correlation with absolute income is -0.36.

Given that the students are naturally clustered into schools, we employ hierarchical linear models and adjust for pupil and school characteristics. Hierarchical models are a generalisation of linear regression which explicitly account for the grouped or hierarchical structure of data, in our case pupils (level 1) clustered within schools (level 2). In their simplest form, they allow for a school-specific shift of the regression line, and more generally they can accommodate greater flexibility in functional form. They are appropriate for settings such as ours also because grouped data frequently violate the assumption of independence across observations – in our case, because we would expect exam scores to be clustered by school. Hierarchical models explicitly account for such clustering, and as a result are popular in educational settings (Paterson and Goldstein 1991, Schagen and Schagen 2005, Leckie and Goldstein 2015). Formally, our general model can be written as

$$y_{ij} = \beta_0 + \sum_{k=1}^{K} \beta_k x_{kij} + \sum_{p=1}^{P} \gamma_p z_{pj} + \mu_j + \epsilon_{ij}, \qquad (3)$$

where y_{ij} is the achievement score for child *i* in school *j*, β_0 is the constant term, β_k (k=1,…,K) are the K regression coefficients corresponding to K level-1 regressors; x_{kij} is the value of x_k for child i in school j. γ_p (p=1,...,P) are the P regression coefficients corresponding to level-2 regressors where z_{pj} is the value of z_p for school j. Finally, μ_j is the school-level random effect for school j where $\boldsymbol{\mu} \sim N(0, \sigma^2)$ and the parameter σ^2 is estimated as part of the model, while ϵ_{ij} is the individual-level error.

For each model we report robust standard errors that are clustered at school level. Robust standard errors are called for because our data are not from a random sample, and we cannot a priori assume that error terms are independent and identically distributed. Therefore, beyond school-specific random effect using hierarchical models, we additionally cluster errors by school because exam scores are likely to be correlated within schools. We also include control variables at the individual level (gender, age, race, parents' education, Brazilian born, disability and household size) as well as at school level (rural location and whether the school administration is municipal, state, federal or private). Descriptive statistics for our variables are shown in Table 1.

Table 1: Descriptive statistics				
Pupil characteristics (N=240,340)	**Mean**	**S.D.**	**Min**	**Max**

ENEM score average	548.631	80.691	299.540	853.220
Age (years)	17.878	1.083	14	25
Female	0.588			
Has disability	0.001			
Brazilian national	0.999			
Race				
White	0.474			
Black	0.152			
Mixed	0.352			
Asian descent	0.017			
Indigenous	0.004			
Income (‘000 BRL)	331.074	414.005	0.000	2068
Income (rescaled)	0.160	0.200	0	1
Relative deprivation	0.109	0.117	0	0.992
Household size	3.850	1.063	1	6
Mother is a graduate	0.234			
Father is a graduate	0.197			
School characteristics (N=2,422)				
Type				
Federal	0.019			
State	0.474			
Municipal	0.022			
Private	0.484			
Location				
Urban	0.961			
Rural	0.039			

3.3 Qualitative phase

The data collection took place during February and March 2019 in Rio de Janeiro, so that quantitative and qualitative results concern the same context. The importance of aligning qualitative and quantitative sampling in mixed methods research primarily concerns concurrent rather than sequential designs like ours (Sykes, Verma and Hancock 2018), and the phenomena we are interested in are unlikely to be unique to a certain geographical area. Yet, given the large sociodemographic heterogeneity of the Brazilian subcontinent, we wanted our quantitative and qualitative data to refer to largely the same context and our qualitative insights to be offered by teachers from the area the quantitative data refers to. We purposively selected 7 high schools, of which 5 were standard high schools and 2 were technological high schools – where the curriculum places a greater emphasis on applied subjects. For both categories, we selected high- and low-performing schools in terms of

ENEM average results in previous years. While we only visited federal, state and municipal schools, some of the teachers we interviewed were also employed in private schools – having multiple teaching assignments across schools is common in Rio de Janeiro (Elacqua and Marotta 2020). Principals facilitated our access to teachers, who were selected across ages and genders to have a range of perspectives and teaching experience. Of the 30 teachers participating in our research, 23 were females and 7 were males, with an age range between 29 and 69. We carried out 13 semi-structured interviews and 3 Focus Group Discussions (FGDs, with 4, 5 and 8 teachers). FGDs and most interviews were arranged in advance based on teachers' schedules, and in some cases we were able to interview teachers who were available during the days we visited the schools. All sessions took place in the school premises and only one case a teacher we approached declined to be interviewed. In each interview we presented participants with our quantitative evidence (an overview of basic descriptive statistics and an explanation of our econometric results) and invited them to comment on possible explanations for our results. Interviews were fully transcribed and the quotes reported in this paper are our translations.

4. Quantitative results

Our quantitative results are presented in Table 2, which displays 7 econometric specifications. Each model is hierarchical with two levels, pupil and school, and includes year fixed effects as relevant. Specifications 1-4 pool observations across 2016, 2017 and 2018 and differ in the inclusion of explanatory variables: 1 only includes our variables of interest (income and relative deprivation), 2 adjusts for pupil characteristics, 3 adjusts for school characteristics and 4 includes both individual and school covariates. Specifications 5-7 also include both individual and school covariates, but they provide results for year-wise subsamples to examine whether results for specific years are in line with the overall pattern.

Table 2: Hierarchical linear models for ENEM scores: full sample and year-wise

	(1)	(2)	(3)	(4)	(5) 2016	(6) 2017	(7) 2018
Income	28.86[a]	22.39[a]	28.64[a]	22.15[a]	27.03[a]	24.36[a]	26.32[a]
	(1.43)	(1.23)	(1.42)	(1.22)	(1.78)	(1.68)	(2.02)
Relative deprivation	-54.91[a]	-35.63[a]	-54.77[a]	-35.70[a]	-31.59[a]	-33.05[a]	-36.14[a]

	(1.28)	(1.17)	(1.28)	(1.18)	(1.76)	(1.75)	(2.28)
Female		-5.99[a]		-5.94[a]	-6.87[a]	-4.53[a]	-6.22[a]
		(0.25)		(0.25)	(0.38)	(0.42)	(0.51)
Race							
White		(base)		(base)	(base)	(base)	(base)
Black		-9.50[a]		-9.40[a]	-9.06[a]	-9.02[a]	-11.25[a]
		(0.37)		(0.37)	(0.54)	(0.57)	(0.70)
Mixed		-5.66[a]		-5.61[a]	-5.78[a]	-5.79[a]	-6.50[a]
		(0.27)		(0.27)	(0.43)	(0.43)	(0.53)
Asian descent		-6.48[a]		-6.43[a]	-5.53[a]	-5.63[a]	-9.67[a]
		(0.88)		(0.88)	(1.40)	(1.39)	(1.73)
Indigenous		-12.81[a]		-12.77[a]	-14.42[a]	-9.53[b]	-14.10[a]
		(1.76)		(1.76)	(2.73)	(3.00)	(3.30)
Mother is a graduate		5.99[a]		5.90[a]	6.52[a]	5.79[a]	7.08[a]
		(0.37)		(0.37)	(0.58)	(0.59)	(0.72)
Father is a graduate		5.86[a]		5.80[a]	5.84[a]	6.00[a]	7.22[a]
		(0.37)		(0.37)	(0.57)	(0.62)	(0.73)
Age		-10.58[a]		-10.49[a]	-9.96[a]	-10.25[a]	-11.82[a]
		(0.19)		(0.19)	(0.25)	(0.24)	(0.31)
Has disability		-25.93[a]		-26.05[a]	-20.66[a]	-25.14[a]	-39.77[a]
		(3.63)		(3.63)	(4.73)	(5.93)	(8.82)
Household size		-2.10[a]		-2.06[a]	-2.22[a]	-1.96[a]	-2.07[a]
		(0.11)		(0.11)	(0.16)	(0.17)	(0.21)
School type							
Federal			(base)	(base)	(base)	(base)	(base)
State			-113.40[a]	-108.22[a]	-111.37[a]	-104.17[a]	-113.24[a]
			(5.26)	(4.97)	(5.80)	(4.63)	(4.86)
Municipal			-106.38[a]	-99.11[a]	-102.22[a]	-89.73[a]	-76.79[a]
			(7.24)	(6.60)	(7.78)	(7.42)	(9.19)
Private			-48.99[a]	-54.47[a]	-59.67[a]	-52.50[a]	-49.88[a]
			(5.45)	(5.14)	(5.95)	(4.83)	(5.07)
Location							
Rural			(base)	(base)	(base)	(base)	(base)
Urban			3.47	6.63[b]	8.30[b]	5.99[c]	5.98[c]
			(2.64)	(2.46)	(2.70)	(2.58)	(2.77)
Constant	536.58[a]	738.68[a]	613.59[a]	810.92[a]	803.84[a]	805.70[a]	847.76[a]
	(1.14)	(3.78)	(5.77)	(6.62)	(7.89)	(6.74)	(8.16)
SD (School random effect)	49.83[a]	44.51[a]	36.56[a]	33.80[a]	33.35[a]	32.89[a]	35.02[a]
	(0.82)	(0.79)	(0.75)	(0.71)	(0.78)	(0.76)	(0.82)
SD (Residual)	54.80[a]	53.57[a]	54.80[a]	53.57[a]	51.51[a]	51.25[a]	57.60[a]
	(0.17)	(0.17)	(0.17)	(0.17)	(0.21)	(0.19)	(0.26)
Year fixed effects	Yes	Yes	Yes	Yes	-	-	-
Observations	240,340	240,340	240,340	240,340	87,763	83,405	69,172

Robust standard errors clustered by school in parentheses. [c] $p < 0.05$, [b] $p < 0.01$, [a] $p < 0.001$

Across all our specifications, absolute income and relative deprivation are highly significant (p<0.001), with a positive sign for the former and a negative sign for the latter. Their statistical significance when they are jointly employed in our regressions suggests the relevance of both the material and psychosocial dimensions of socioeconomic pathways to educational attainment. The magnitude of both coefficients reduces once we adjust for pupil and school characteristics, decreasing from 28.86 (income) and -54.91 (relative deprivation) in specification 1 to 22.14 and -35.70 respectively in specification 4. This reduction is not surprising given the strong correlation in Brazil between economic status and sociodemographic characteristics such as parent education, race and school administration. These results indicate that after adjusting for pupil and school characteristics, exam scores are 35.70 points lower if we compare the most with the least relatively deprived pupils, and 22.14 points lower comparing those with the lowest incomes to those with the highest. Considering that the raw (un-modelled) difference in scores between pupils from the richest and poorest households is approximately 200 ENEM points, results from our multivariate hierarchical regressions show that a large proportion of this difference is explained away by the correlation between economic status and other characteristics. Specifically, the hierarchical model purposively accounts for between-school variation in scores given that pupils are likely sorted into schools according to several factors including neighbourhood and economic status.

Control variables display the expected signs. Exam scores are higher for pupils whose mothers or fathers are graduates, while they are lower for females (on average 5.98 lower than males), older pupils and those in larger households, and those who are not white – in particular, scores for blacks and indigenous students are on average 9.40 and 12.77 points lower than for whites, respectively. Having a disability is associated with an average reduction of 26.05 points. We also observe that federal schools (the base category) have the highest average scores, followed by private (with a gap of almost 50 points), and then state and municipal schools (with a gap of over 100 points). The estimated standard deviations of the two random-effects components are statistically significant. In the case of school effects, this term captures the effects of school-level unobservables as (e.g. teacher quality). We would therefore expect these random effects to have substantive variation, and indeed the standard deviation is of comparable magnitude to the coefficients of income and relative

deprivation. The standard deviation for the residuals captures remaining unobserved heterogeneity, and indicates that, as expected, there are important factors determining the variation in ENEM scores beyond our explanatory variables.

We also estimate several additional models as robustness checks, results of which are available upon request. The signs of income and relative deprivation remain unchanged across all models and statistical significance maintains, which reassures us with regard to the stability of our results. First, in lieu of hierarchical models, we estimate simple linear regressions with school fixed effects. Second, we carry out subsample-wise estimates for different municipality sizes to investigate potential heterogeneity in this regard, creating four subsamples viz. Rio de Janeiro (state capital and largest municipality), municipalities with over 12,000 observations, those between 12,000 and 1,000, and those with less than 1,000. Third, we created subsamples according to group size, motivated again by potential heterogeneity and also as an indirect test for whether smaller groups could lead to bias.[2] Fourth, we use income as the original 17-category variable and find that the association of achievement with income is generally monotonic across adjacent categories. Fifth, we estimate a 3-level hierarchical model with municipalities as the third level; the municipality-level random effect is statistically significant, evidencing variation in scores at this level, but with a standard deviation roughly a third of the school random effect, this variation is comparatively smaller. As mentioned in the methods section, we execute a number of robustness checks using alternative measures of relative deprivation. Finally, Likelihood-ratio tests support the use of hierarchical models over customary linear regressions ($p<0.001$ for all specifications).[3]

5. Qualitative insights and discussion

Teachers ascribed the positive relationship between absolute income and ENEM scores to broadly two types of factors. The first set relates to the inputs which higher economic means are able to afford, ranging from educational inputs such as computers, books and private

2 The literature suggests that hierarchical models are generally well-behaved and provide unbiased results even if group size is small provided that the number of groups is relatively large (Theall et al 2011, Maas and Hox 2005). Theall et al. (2011) use simulation to investigate the behavior of hierarchical linear and logistic regression models with group sizes between 1 and 5, and find that both fixed and random components of the models are estimated without bias provided group sizes are large (in their example, with 459 groups). In our data, the number of schools is large (2422) so that bias is unlikely, and the number of observations per school varies between 1 to 1143, with a mean group size of 99.2.

3 We note that this since this test cannot be run on specifications employing robust clustered standard errors, we have carried it out on specifications using regular standard errors.

tutorials, to a number of factors which puts students from wealthier households better placed to study – being taxied to school in private means of transport, receiving proper nutrition, having a more comfortable space to study in their homes and living in safer neighbourhoods. The second type concerns the need to contribute to the household economy by engaging in paid work, which teachers reported as very common for poorer students, with detrimental effects on educational outcomes. Emerson and Souza's (2008) findings that in Brazil older siblings are more likely to engage in child labour as they are able to command higher wages suggests that high-school students may face particular pressure to bring home money. This pressure is multifaceted, with education suffering from a combination of material hardship and skewed incentives:

> *"'Teacher, I need to take advantage of my youth to work in a shop, as in a few years I will not be able to.' And when you try to talk about the importance of education for their future, they tell you that their siblings are hungry now."* (FGD 3, Teacher 3)

The detrimental role of relative deprivation resonated as very familiar to our teachers. They argued at length how a lower position in the economic hierarchy undermines students' self-confidence, jeopardises conviction in their own abilities, curbs their aspirations and generates stress, frustration and alienation:

> *"A sensation of not believing in yourself… parents themselves don't, and project this onto their children. In between the lines, the family and the whole society all repeat this to lower economic status children… sending subliminal messages which stick on the children's mind as: 'I am not as good as others, no point in studying.'"* (Teacher 1)
>
> *"It relates to expectations, which are in large part what activates youth, especially with regard to educational attainment… lower status students develop lower expectations, have less motivation."* (Teacher 5)
>
> *"It generates frustration and affects self-esteem. Lower status students see the opportunities others have, and for adolescents it is very difficult…they are very 'immediatist' and live things as if it was their last day."* (FGD 3, Teacher 2)

These words of our teachers echo a body of literature across disciplines. Lower socioeconomic status was found to negatively affect students' self-esteem (Chen and Paterson 2006) as well as adults' self-assessed intelligence (Kudrna, Furnham, and Swami 2010), and poorer students were found to overestimate the academic abilities of their richer peers (Régner, Huguet, and Monteil 2002). Relative deprivation was found to be associated with the intensity of students' depressive symptoms (Kim, 2020) as well as a range of psychosomatic symptoms – irritability, feeling low, feeling nervous, sleep difficulties, headache, stomach ache, back ache and feeling dizzy (Elgar et al 2013). The research by Mayer (2001) and Destin and Oyserman (2009, 2010) provides a framework that fits

particularly well our teachers' description of the motivational and aspirational impact of lower economic status. One teacher drew a parallel between the role of relative deprivation and the expression used as the title for 'Nunca me sonharam' (Nobody ever dreamed me/of me), a recent documentary about the challenges in Brazilian high-school education. The expression comes from the comment made by an underprivileged student who explained his disengagement with education in terms of nobody ever dreaming of him as a doctor, an engineer or any other role in society for which it would make sense for him to study. Due to the lack of motivation and aspirations, the teacher explained, going to school had for him become just a meaningless, repetitive act.

Teachers commented that they saw the effects of lower economic status occurring at any income level – affecting not only those at the very bottom of the economic ladder, but also those who are well off but worse off than others in their social milieu, in particular their school. They mentioned that also children of average-earning doctors or lawyers happen to suffer from unfavourable comparisons when they study in elite schools where they peers are very affluent (illustrative examples included affording to go to Disney for the weekend or to travel to Barcelona just to see a football match). They reported cases of students who managed to enter elite schools thanks to scholarships but suffered from not being able to join the lifestyle of their schoolmates, and how this in turn negatively affected their academic performance. Teachers whose own children managed to enter an elite private school reported:

> *"I told him: 'Listen, son, you will be able to attend this school because I work there, but you have to know that you will not be able to do what your schoolmates will do, as we cannot afford it.'"* (Teacher 9)
>
> *"My daughter went to a school where other students were very rich, and once I heard her telling an intimate friend: 'I don't invite my schoolmates to mine as their bedroom is as large as my whole house.'"* (Teacher 13)

Teachers explained that lagging behind others and being unable to meet the reference pattern students see around them generates frustration and alienation, as this inability impinges on their need to fit in. The youngest amongst our interviewees stressed how the negative effects of upward comparisons are magnified by the growing use of social media. Interestingly, while teachers gave many examples related to the possession of material items owned by peers (e.g. fashionable clothes and handbags), they argued that unequal access to culturally and intellectually enriching experiences (e.g. travels, museums, theatre) are also among the domains of comparison:

"'There are things I have no access to, information my schoolmates bring into the school which are intangible. There is no way I can match them… I am doomed to fail.' I think there are many students thinking in these terms." (Teacher 6)

6. Conclusion

In this paper we have added a novel contribution to the literature on relative income. We have provided evidence of a negative relationship between relative deprivation and educational outcomes, and, importantly, we have gone a step further in the interpretation of this result. This negative relationship between relative deprivation and educational outcomes is explained by the local teachers we interviewed along the understanding of relative deprivation measures as quantifying the harmful effects of upward social comparisons, as suggested by Hey and Lambert (1980). Lower standing in the socioeconomic hierarchy depresses self-confidence, curbs aspirations, and fosters the creation of rigid/crystallised identities of pupils and parents alike who are unable to see social mobility as a concrete possibility.

It would be clearly naïve to believe that this is *the* only plausible interpretation of relative deprivation measures, as relative income can also matter in the interpretation provided by Yitzhaki outlined above. Another interesting way to think about what relative deprivation can represent is suggested by Bourguignon (1999) – a measure of the competitive disadvantage experienced by those lower down in the distribution, in particular in presence of asymmetric information and credit market constraints. Different takes on relative income measures may be more fitting depending on the social outcome of interest and/or the context, and it cannot be excluded that in some cases more than one interpretation may be appropriate. Engaging with qualitative data collection to enable a deeper understanding of multifaceted shades of economic inequalities is a clear avenue for future research.

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