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RESEARCH PAPER

The Paradox of Wealthy Nations' Low Adolescent Life Satisfaction

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Abstract
Using PISA 2018 data from nearly half a million 15-year-olds across 72 middle- and high-income countries, this study investigates the relationship between economic development and adolescent subjective well-being. Findings indicate a negative log-linear relationship between per-capita GDP and *adolescent* life satisfaction. The negative nexus stands in stark contrast to the otherwise positive relationship found between GDP per capita and *adult* life satisfaction for the same countries. Results are robust to various model specifications and both macro and micro approaches. Moreover, our analysis suggests that this apparent paradox can largely be attributed to higher learning intensity in advanced countries. Effects are found to be more pronounced for girls than for boys.

Keywords Economic development · Adolescent life satisfaction · Learning intensity · Education competition · Mental cost · PISA

JEL Classification I31 · I25 · I15

1 Introduction

> A little stress is a good thing. It can motivate students to be organized. But too much stress can backfire.
> Mary Alvord.

The relationship between long-run economic growth and the advancement of living conditions is one of the firmest and most agreed-upon findings in modern macroeconomics. Compared to those living in low- and middle-income nations, residents of high-income nations enjoy higher levels of consumption, leisure, health, and education (UNDP, 2020; World Bank, 2020). Residents of advanced nations further report higher mean levels of experienced utility, i.e., subjective well-being (SWB), such as higher satisfaction with their lives and greater happiness. Hence, across countries, a positive, log-linear relationship

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between per-capita GDP and average life satisfaction has been constantly shown by past studies (e.g., Deaton, 2008; Stevenson & Wolfers, 2013). These past studies, however, use samples of countries' *adult* populations. While some studies have examined the average SWB of *children* and *adolescents* from cross-country perspectives (e.g., Bălțătescu, 2021; Campbell et al., 2021; Marquez & Main, 2021; OECD, 2020), the relationship between economic development and the SWB of children and adolescents has remained largely unexplored. The current study aims to fill this gap by using data from the OECD's 2018 PISA round, which collected comparable data on SWB for 15-year-olds across a significantly larger number of countries (72) than earlier rounds.

A priori, it is not clear whether the positive gap in experienced utility that has been found between adults of advanced and less-advanced countries also holds for children and adolescents. In fact, previous research has shown that international differences in SWB of adults can largely be explained by country-level characteristics (Helliwell et al., 2019), while international differences in the SWB of children and adolescents is mostly explained by factors like the child's home, school, and community context (Lee & Yoo, 2015). In particular, to the extent that modern knowledge-based economies require ever increasing investments into human capital at early stages in life (Becker et al., 1990; World Bank, 2017), children and adolescents in wealthier nations may experience disutility arising from growing learning intensities and associated school-related stress compared to their counterparts in less-wealthy nations (Heller-Sahlgren, 2018; Hofmann & Mühlenweg, 2018; Quis, 2015; Steinmayr et al., 2016).[1] In order to deal with a higher learning intensity students in advanced nations are required to exert a higher cognitive effort, which in recent neuroeconomics literature is found to give rise to a "mental cost" of education (Shenhav et al., 2017; Westbrook & Braver, 2015). This effect could potentially lower experienced utility (i.e., SWB) of adolescents in advanced countries during school years. As long as basic needs are met, children and adolescents in middle-income countries might therefore experience more satisfying childhoods, albeit this might reverse once they enter the labor market and face greater difficulties finding a decent job. Such mental costs stemming from cognitive effort could be regarded as hidden costs of education that have so far been largely ignored by economists as well as policy makers.

Educational policies aimed at raising school productivity and educational quality often include, among other factors, an increase in the intensity of learning. Higher learning intensity can manifest itself in various ways that all contribute to a rise in a student's cognitive workload: an increase in the number of tasks to be solved in each class hour, an increase in the difficulty level of tasks, and/ or an increase in the number of study hours per

[1] We define learning intensity as the product of quantity and complexity of learning tasks completed by a student within a given time period, e.g., a school year. The amount of learning that happens in school is known to be positively correlated with the level of economic development of a country. Due to differing returns to education across nations, Becker et al. (1990) concluded that "societies with limited human capital choose large families and invest little in each member; those with abundant human capital do the opposite". Hence, parental investment in education of their offspring is highest in high-income countries, and so are the expectations that teachers and parents have in the actual cognitive efforts that children exert (Becker et al., 1990; Mincer, 1984). Given the importance of education and the overall level of development, high-income countries also provide higher school quality (World Bank, 2017; 2021). According to the World Bank (2017), "37 million African children will learn so little in school that they will not be much better off than kids who never attended school". The secular expansion of schooling and of cognitive effort over the twentieth century economic development processes of OECD nations have further been associated with generational gains in intelligence levels and growth in the human prefrontal cortex (Blair et al., 2005; Flynn 1984, 1987).

week (Bălțătescu, 2021; Krell, 2017; Kuan, 2018). While a higher learning intensity tends to increase a student's academic achievement, it might come at the cost of reduced leisure and well-being. It thus inevitably reduces time and cognitive energy for extra-curricular activities and recreation which, in turn, could adversely affect a student's experienced utility. Hofmann and Mühlenweg (2018) and Quis (2015) examine the impact of a recent education reform in Germany which increased learning intensity in Germany's higher secondary education track. Both studies find reductions in self-rated mental health among students affected by the reform which reduced senior high school by one year. Bălțătescu (2021) uses PISA 2015 data to show a negative relationship between average weekly study hours of 15-year-olds in a country and average adolescent life satisfaction. Using data for Taiwanese 9th graders, Kuan (2018) finds that cram schooling increases both academic achievement and depression among adolescents.

In a cross-country perspective, adolescents in high-income economies show higher average academic performance compared to those in low- and middle-income economies (OECD, 2019a). In a review of the literature on education production, Hanushek (2020) concludes that family and peer effects contribute more to explaining individual academic performance than school and teacher effects. In a high-performing education environment, a student who wants to keep up with average peer performance must adopt a higher level of study input (time and/or cognitive effort) compared to a student in a low-performing education environment. Since students derive part of their own well-being from peer status (Plenty & Mood, 2016), the average student will be likely to exert a greater study effort in a high-income country, even if it comes at higher mental cost. This can give rise to country-level differences in education intensity and, if study effort is indeed a mental burden, will affect country-level differences in adolescent SWB. In two recent studies, Kim et al., (2022a, 2022b), using a quasi-experimental setting from Korea, find that peer participation in after-school private tutoring increases students' participation in private tutoring and negatively affects their mental health. Heller-Sahlgren (2018) uses PISA 2012 data to show that higher competition among schools raises instruction time and homework, and reduces student well-being. Gibbons and Silva (2011) further point to the role of parents in driving education competition. The authors find that peer quality and school value-added dominate student well-being as predictors of parental satisfaction with schools, thus generating stronger incentives for schools to focus on the former.

Why then should one care about such mental costs of education, given that education, on average, is an investment with a positive net return? Firstly, well-being during childhood and adolescence matters in its own right. Children have the right to live free from fear and abuse, as well as to receive basic education to enable them to lead an informed and cultivated life (UNGA, 1989). Yet, in advanced countries, education can sometimes become a serious threat to child safety. A significant share of 15-year-olds in OECD countries study longer than the permitted legal working hours for employees. For example, the legal maximum work week in South Korea is 52 h, yet 23 percent of students aged 15 studied 60 h or more per week in 2015. In England, the share of students studying 60 h or more was 11 percent, while it was 16.5 percent in Spain (Bălțătescu, 2021). In many countries, cultural norms dictate how much students are supposed to study, and given that much of studying happens at home, governments have so far failed to prevent abuse. Secondly, earlier literature suggests that child and adolescent well-being is linked to later-life outcomes. Longitudinal studies show that positive well-being during childhood and adolescence are significant determinants of positive well-being, mental health, earnings, and the absence of unemployment in later life (Clark & Lepinteur, 2019; De Neve & Oswald, 2012; Layard et al., 2014; Lundborg et al., 2014). Thirdly, from a life-course perspective,

adolescence seems to be a key window for intervention. Solmi et al. (2022) show that the global peak age for the onset of mental health problems is 14.5 and according to Casas and González-Carrasco (2019) SWB starts to decline in adolescence. Lastly, if indeed such mental cost represents a cost that was so far overlooked by human capital investment models (Becker, 1993; Robeyns, 2006), then optimal investment choices might have been exaggerated. When making decisions, however, people might have implicitly already factored in such mental costs, since they might be (at least partly) aware of the mental effort it takes to receive an educational degree.

The aim of this study is to examine the relationship between a country's level of income and adolescent well-being from a macro perspective. Using data from the OECD's 2018 PISA round for nearly half a million 15-year-olds from 72 middle- and high-income countries, to the best of our knowledge, this is the first study to investigate this nexus for a larger sample of countries. In addition to uncovering the nexus, we further aim to examine some of the factors affecting the relationship, in particular learning intensity and education culture.

The remainder of this article is organized as follows: Sect. 2 identifies two related strands of literature that are most relevant for our study. Section 3 presents the dataset, key variables, and estimation methods. Section 4 presents the main results and extensions to our main analysis. Section 5 discusses the findings and concludes.

2 Related Literature

Scholarly interest in the SWB of children and adolescents is a relatively new development (Ben-Arieh, 2008). During the last decade, however, scientists have produced a substantial amount of evidence on the topic (see the background section in Marquez & Main, 2021, for an overview). Within this literature, two strands are of particular interest to us. One strand of studies examines child and adolescent SWB from a cross-country perspective and the other strand analyzes the link between schoolwork pressure and student well-being. Our paper fits squarely into this existing literature: first, we take a macro perspective and conduct a cross-country analysis to reveal a negative, log-linear relationship between per-capita GDP and average levels of adolescent SWB. Second, we draw on the existing literature on schoolwork pressure to argue that experiences in the educational sectors might be an important mechanism behind the observed negative nexus.

Studies on child and youth well-being are usually conducted using micro data, often for a single country. These studies consistently find that demographic and socio-economic variables can explain only a limited portion of the variation in adolescent life satisfaction (Gilman & Huebner, 2003, 2006). Indeed, most of its variance can be ascribed to intrapersonal factors (i.e., personality; gender) and interpersonal environmental factors (i.e., relations with family and friends; culture) (Campbell et al., 2021; Coupe & Obrizan, 2018; Lee & Yoo, 2015; Levin & Currie, 2010; Morgan et al., 2012). There is, however, a growing number of studies that uses cross-country data to examine children's and adolescents' life satisfaction. Marquez (2021) conducts a comparative study using PISA 2015 data from 33 high- and middle-income countries (among them 23 OECD countries). The study focuses on the link between students' life satisfaction and their schools but also on how this link might differ depending on the students' socioeconomic status. Interestingly, the author finds that schoolwork-related anxiety is negatively affecting students' life satisfaction in all 33 countries. Only in some countries, distinct school-related factors may shape students'

life satisfaction differently for students of higher and lower socioeconomic status. Marquez and Main (2021) study the same 33 countries and investigate links between education-policy-relevant factors (such as schoolwork-related anxiety, frequency of suffering from bullying, and feeling emotionally supported by parents in matters related to school) and students' SWB. The authors interpret their results as an indication that schools may play an important role in shaping students' life satisfaction. The two authors, however, qualify this statement, pointing out that the association may be of a complex nature. Campbell et al. (2021) uses PISA 2018 data from over half a million adolescents across 73 countries to examine gender gaps in several mental health outcomes. Their main finding suggests that lower mental health among female adolescents relative to boys is largely ubiquitous. Lee and Yoo (2015) conduct a comparative study using ISCWeB data for approximately 12,000 children from 11 countries. They find that economic variables such as GDP per capita and the Gini index for income inequality are not significant when predicting children's SWB. Instead, variables like the frequency of family and peer activities, or neighborhood safety, are found to be more important for child well-being. Noting, however, that most data were collected based on convenience—rather than random—sampling methods, the authors stress that the generalizability of their results is limited.

The second strand of literature related to our paper examines the relationship between student well-being on the one hand and schoolwork pressure and student life more generally on the other hand (Choi (2018) provides a good introduction into the topic). Earlier literature has identified the following factors to be associated with student well-being: peer relationships, teacher-student relationships, feeling supported by parents at school, a sense of belonging at school, and school-related stress (Chiu et al., 2016; Lee & Yoo, 2015; Lemma et al., 2015; Marquez & Main, 2021; Moksnes et al., 2016; Proctor et al., 2009; Steinmayr et al., 2016). Student life in its generality also encompasses domains as diverse as academia, safety and/or time use. Kosher and Ben-Arieh (2017), for example, explore the empirical association between children's rights and children's well-being. The authors conclude their cross-national comparison with the statement that knowing and thinking about their rights is an indicator of child well-being. The article by Högberg (2021) identifies stress factors among adolescents. For this purpose, he uses data from the Health Behavior in School-aged Children (HBSC) survey which includes more than 150,000 adolescents in 33 European countries. The author finds that a country's per capita GDP growth, but not educational expansion (measured by the change of the tertiary attainment rate), contributes to more school stress in adolescents. The effect of stress on mental health problems therefore becomes stronger as countries grow richer (and more educated). In fact, Heller-Sahlgren (2018) showed that more school competition raises academic achievement on the one hand but decreases student well-being on the other hand. The author speculates that the causal mechanism might be related to the stress levels of the affected students. The results produced by Steinmayr et al. (2016) support this viewpoint. Using a cross lagged model, they show that test anxiety adversely affects student's life satisfaction. Steinmayr et al. (2018) also stress the role of test anxiety as a predictor for SWB.[2] Another aspect of students' lives that has been studied in previous research on children's SWB is time-use

[2] A growing body of literature documents declining levels of adolescent SWB between the ages 10 and 15 (Casas and González-Carrasco, 2019). If it is true that schoolwork pressure and test requirements increased during early teen age, it would be advisable to control for education-related factors (Wiklund et al., 2012). Comparing PISA 2015 and 2018 data, Marquez and Long (2021) find declining levels of adolescent life satisfaction in 39 out of 46 countries over time.

(Rees, 2017; Rees and Main, 2015). Analyses suggest that helping around the home and taking care of family members are more common in lower-income countries whereas playing sports, watching TV and using computers are more common in high-income countries (Rees, 2017). Moreover, it is shown that across almost all countries boys more than girls use computers and play sports whereas girls more than boys help with housework and read for fun (Rees and Main, 2015). Arguably, autonomous activities like playing sports or watching TV are more fun than helping around the home and taking care of family members. As a consequence, one would expect a positive relationship between per-capita GDP and adolescent life satisfaction. The fact that we find a negative nexus underscores the importance of education-related factors.

Our paper contributes in two ways to the two strands of related literature. First, we add the macro perspective to the already rich evidence on cross-country comparisons with respect to adolescents' SWB. Following the example of Deaton (2008) and Stevenson and Wolfers (2013), we use country-level averages to investigate the nexus between per-capita GDP and adolescent SWB. Second, our analysis adds to the ongoing debate among scholars about the underlying mechanisms by highlighting a few macro-related aspects such as cross-country differences in educational culture. In particular, we will investigate the country-specific levels of academic performance, student competition and student cooperation. Lastly, we contribute to the literature on the cost of education. Our cross-country analysis suggests an additional *mental cost* of education that might have been overlooked or underestimated by past studies focusing on only a single country.

3 Data and Estimation

3.1 Data Sources

This study uses data from the 2018 round of the OECD's PISA (Program of International Student Assessment). Some 600,000 students completed the assessment in 2018, representing about 32 million 15-year-olds in the schools of 79 middle- and high-income countries and economies (OECD, 2021). SWB questions have been included in PISA student questionnaires for 72 countries/ economies, which allows for an in-depth analysis of adolescent well-being across countries of 493,202 students.[3] In addition to PISA data, we use country-level variables[4] from the WDI (World Bank, 2020), UNESCO UIS (2021), and the 2018 Gallup World Poll as reported by Helliwell et al. (2019).

3.2 Key Variables

In the following, this study's analysis will focus mainly on adolescent *life satisfaction* as the main dependent variable (Diener, 1994; OECD, 2013). Life satisfaction refers to an individual's evaluation of quality of life in general and has been commonly used as

[3] Among the 72 countries that measured life satisfaction, the measure was reported by 92.4 percent of students. PISA 2018 data does not contain math, reading, and science scores for Vietnam, and for Spain it does not contain reading scores. When test scores were reported for a country, they were reported for 100 percent of students, without any missing values.

[4] All variables are measured for the year 2018. In case of missing values in 2018, the earliest year available is being used.

a measure of SWB by social scientists of various disciplines. According to Park (2004), adolescent life satisfaction presents a comprehensive measure of adolescent psychological well-being. In PISA 2018 interviews, life satisfaction was measured according to common standards by asking students: "Overall, how satisfied are you with your life as a whole these days?"; and using a response scale from "0" indicating 'not at all satisfied' to "10" indicating 'completely satisfied'.

Besides the overall evaluation of one's life, further aspects of SWB that are often used in the literature are experience and eudaimonia (Dalziel et al., 2018; Diener, 1994; OECD, 2013). *Positive emotions* (such as feeling happy) and *negative emotions* (such as feeling sad) represent the experience aspect of SWB while *meaning in life* refers to SWB's eudaimonic aspect. The latter represents Aristotle's understanding of eudaimonia as 'living well' or 'human flourishing'. While this article focuses on life satisfaction as the main dependent variable, it will also show the effect of economic development on experience and eudaimonia.[5]

Following common practice, the level of a country's economic development is measured using per-capita GDP in purchasing power parities for the year 2018 (World Bank, 2020). The natural log will be applied to per-capita GDP to account for diminishing marginal utility of income (e.g., Deaton, 2008).

This study further uses three education-related variables from PISA 2018 to account for learning intensity and education culture. First, we calculate student academic performance by averaging over a student's PISA test scores in math, reading and science.[6] We acknowledge that low-stakes exams such as PISA, TIMSS, or PASEC provide imperfect measures of academic competence (Akyol et al., 2021). Nevertheless, their extensive use in earlier literature (e.g., Hanushek, 2013; Lee et al., 2019; World Bank, 2021) suggests that they remain the best available proxies for comparing educational quality and academic performance across countries. Second and third, we use indexes of students' self-reported perceptions of student competition and student co-operation in their schools as constructed by OECD's PISA data team. The roles of competition and co-operation in student outcomes have been discussed in the social interdependence theory (Deutsch, 1949). Social interdependence exists when the outcomes of individuals' actions influence those of others. The way social interdependence among individuals is structured decides how they relate, which then determines outcomes. Positive goal interdependence (co-operation)

[5] Positive and negative emotions were asked in the following manner: "Thinking about yourself and how you normally feel: how often do you feel […]?" (response scale: "1" = 'never', "2" = 'rarely', "3" = 'sometimes', "4" = 'always'). Individual averages across four positive emotions (happy, joyful, cheerful, lively) were used to construct a measure of positive emotions, while averages across four negative emotions (afraid, scared, sad, miserable) were used to construct a measure of negative emotions. Lastly, meaning in life is measured using a 3-item index of perceived meaning in life constructed and provided by the OECD's PISA team. Students were asked to report the extent to which they agree with the statements: "My life has clear meaning or purpose"; "I have discovered a satisfactory meaning in life"; and "I have a clear sense of what gives meaning to my life." The index was scaled using a generalized partial credit model and values of the index correspond to Warm likelihood estimates (WLE). The estimates were then standardized so that the mean of the index value for the OECD student population was zero and the standard deviation was one (equal weight given to countries) (OECD, 2019b; 2021).

[6] We average across all three subjects to proxy for the average level of academic performance by country. However, in a separate robustness check we will examine whether our results hold when using separate test scores by subject.

leads to promotive interaction, negative goal interdependence (competition) results in negative interaction and, no goal interdependence leads to no interaction (Johnson & Johnson, 2005).[7] Some studies show that co-operative goal structures, rather than competitive or independent efforts, can best promote more positive peer relationships, better psychological health, and academic achievement (Roseth et. al., 2008; Aknin et al., 2012). Based on these findings, policy makers have increasingly promoted "co-operative learning" over the past decades. Moreover, according to social comparison theory (Festinger, 1954), which is often used in the analysis of classrooms, people have a fundamental desire to evaluate their opinions and abilities, and often do so by relative comparison with others. Dijkstra et al. (2008) review the literature on social comparison in schools and find that students prefer to compare their performances upward, inducing within-class competition. While upward comparisons motivate students to perform better, it can evoke negative affect and lower academic self-concept. The student competition index used in our study is a composite index generated out of students' agreement to three statements when thinking about their school: "Students seem to value competition"; "It seems that students are competing with each other"; and "Students seem to share the feeling that competing with each other is important". Likewise, student co-operation is a composite index based on the three statements: "Students seem to value co-operation"; "It seems that students are co-operating with each other"; and "Students seem to share the feeling that co-operating with each other is important".

For the cross-country analysis, the three education-related variables as well as adolescent life satisfaction are averaged at the country level using PISA sampling weights, which yields country mean estimates that are representative for all 15-year-old students in each participating country (OECD, 2021). Table 1 provides summary statistics for all variables used in this study, all aggregated at the country level.

3.3 Estimation

The relationship between a country's level of income and adolescent life satisfaction can be analyzed using a linear cross-country regression model of the following form:

$$lifesat_c = \alpha + \beta lny_c + E_c^{'}\zeta + X_c^{'}\Delta + \varepsilon_c \quad (1)$$

where $lifesat_c$ is average adolescent life satisfaction in country c, and lny_c is the natural log of GDP per capita (PPP) of the same country. Moreover, E_c represents a vector of education-related variables that are likely to influence student well-being, including the national PISA test score average as well as country-level averages of student competition and co-operation. We use a country's average PISA performance as a proxy for the learning intensity that students are exposed to in a country. In addition, vector X_c includes a set of control variables including macroeconomic indicators, as well as adult life satisfaction in country c. The error term ε_c is assumed to be well-behaved.

[7] Positive goal interdependence (co-operation) leads to promotive interaction and exists when individuals perceive that they can reach their goals if and only if the people with whom they are co-operatively linked also reach their goals. Negative goal interdependence (competition) exists when individuals perceive that they can obtain their goals if and only if the people with whom they are competitively linked fail to obtain their goals, and results in oppositional interaction. No goal interdependence leads to no interaction.

Table 1 Summary statistics

	Obs	Mean	Std. Dev	Min	Max
Subjective well-being					
Life satisfaction	72	7.24	0.61	5.62	8.76
Positive emotions	72	3.29	0.14	2.88	3.61
Negative emotions	72	2.33	0.17	1.98	2.80
Meaning in life	72	0.15	0.23	−0.40	0.60
County income level					
Ln GDP per capita	72	10.27	0.68	8.90	11.75
Education environment					
PISA national average test score (/100)	71	4.52	0.53	3.34	5.79
Student competition	72	0.05	0.25	−0.51	0.63
Student co-operation	72	0.00	0.22	−0.55	0.65
Control variables					
Adult life satisfaction	70	6.06	0.78	4.64	7.86
Life expectancy	71	77.81	3.72	71.10	84.90
Lower secondary net enrollment rate	61	96.03	5.49	69.20	99.99
Gini of hh income	69	0.41	0.08	0.28	0.65
Youth unemployment rate	71	16.89	10.91	0.45	55.41
Population density	71	523.95	2525.48	3.52	20,305.44
Air pollution (PM 2.5)	68	20.27	15.37	5.94	91.27

Summary statistics of PISA variables calculated using population weights

In an extension to the macro analysis, the relationship between a country's level of income, education, and adolescent life satisfaction can also be estimated using a micro model including macro variables:

$$lifesat_{isc} = \alpha + \beta lny_c + E_c^{'}\zeta + X_c^{'}\Delta + S_{sc}^{'}\theta + I_{isc}^{'}\Phi + \varepsilon_{isc} \quad (2)$$

In Eq. (2), $lifesat_{isc}$ is individual life satisfaction of student i that attends school s in country c. S_{sc} is a vector of school-level variables including peer academic performance, and peer perceptions about student competition and co-operation in school s in country c. It is equivalent to vector E, with the main difference that the aggregation was done on the school level (vector E uses national aggregation). Moreover, I_{isc} is a vector of individual-level control variables including binary variables for sex, single child, migrant background, having an own room, having a desk to study at home, having a quiet place to study at home.[8] Assuming that error terms are well-behaved, both Eqs. (1) and (2) can be consistently estimated using OLS regressions.

[8] Individual-level variables were selected from a larger pool of individual controls. The ones remaining proved to be particularly significant for adolescent well-being.

4 Results

4.1 Main Results

Figure 1 presents the relationship between per-capita GDP and adolescent life satisfaction for 72 middle- and high-income countries for which PISA collected data on SWB. Figure 2 is the equivalent graph for adult life satisfaction for the same set of countries.[9]

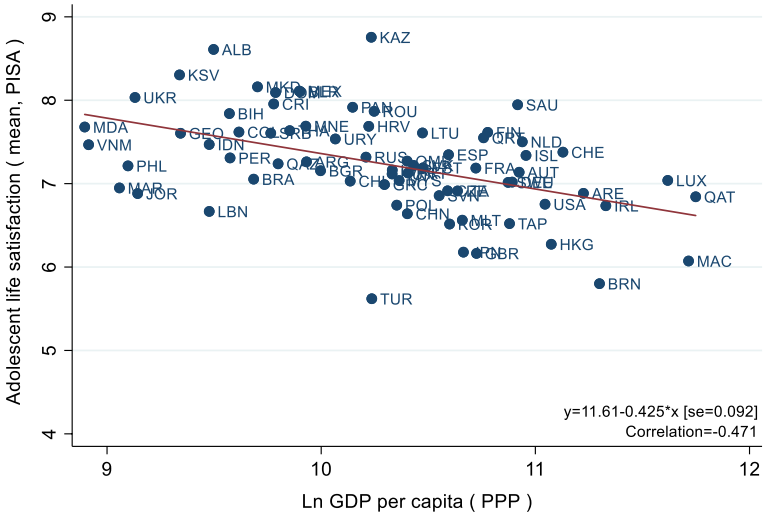

Fig. 1 Per-capita GDP and adolescent life satisfaction in 2018

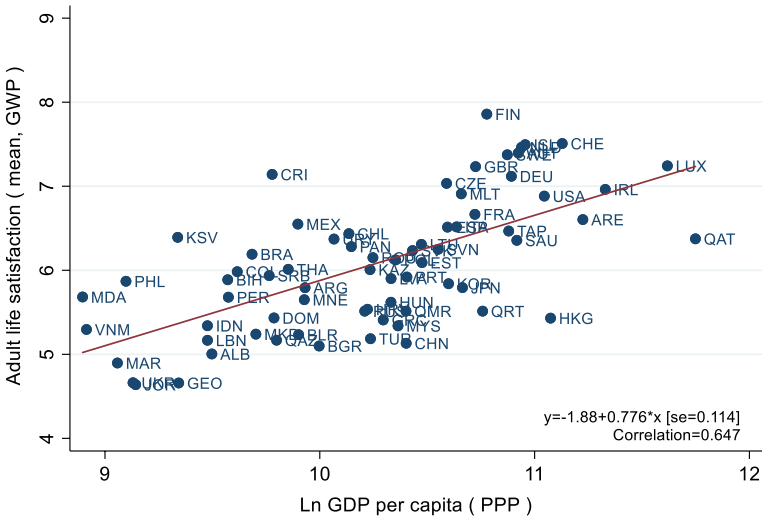

Fig. 2 Per-capita GDP and adult life satisfaction in 2018

[9] Adult life satisfaction is taken from the 2018 Gallup World Poll reported in the World Happiness Report (Helliwell et al., 2019). It is based on the Cantril Ladder. Since data on adult life satisfaction was missing for 2 countries, the number of countries in Fig. 2 is 70.

Table 2 Per-capita GDP and Subjective Well-being

	Adolescent				Adult
	(1)	(2)	(3)	(4)	(5)
	Life satisfaction	Positive emotions	Negative emotions	Meaning in life	Life satisfaction
Ln GDP per capita	−0.425***	−0.0467*	0.0750**	−0.189***	0.776***
	(0.0916)	(0.0280)	(0.0297)	(0.0355)	(0.114)
Constant	11.61***	3.767***	1.558***	2.091***	−1.882
	(0.948)	(0.297)	(0.307)	(0.362)	(1.159)
Observations	72	72	72	72	70
R-squared	0.222	0.051	0.086	0.305	0.419

OLS estimation using PISA 2018 data. Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$

A first visual inspection points towards an apparent paradox. While there appears to be a clear positive log-linear relationship between a country's level of income and adult life satisfaction ($\rho=0.647$), for adolescents this relationship is reversed ($\rho=-0.471$). Figure 3 in the appendix repeats Fig. 1, but now groups countries into ten world regions. The negative relationship is confirmed although there exist significant differences across world regions. CIS and Latin American countries show the highest levels of adolescent life satisfaction, while the lowest levels are found in MENA countries, in North Europe, and Confucian East Asia.[10] Figure 4 in the Appendix further shows a negative relationship between adolescents' academic performance and their satisfaction with life ($\rho=-0.481$), which suggests a potential role of education in explaining the paradox.

Table 2 presents simple bivariate regression estimates for 72 countries and four different measures of adolescent SWB. Column (1) shows a negative and statistically significant relationship between GDP per capita and adolescent life satisfaction. In particular, the coefficient of −0.425 ($p=0.000$) suggests that a doubling of per-capita GDP is associated with a 0.295-points (48 percent of a standard deviation, henceforth SD) lower level of adolescent life satisfaction. Per-capita GDP alone can explain 22.2 percent in the variation in adolescent life satisfaction across countries. The negative nexus between country income level and adolescent SWB is confirmed by the other three SWB measures in columns (2) to (4). Higher incomes tend to increase negative emotions, to reduce positive emotions (albeit only marginally significant), and to reduce perceived meaning in life. Column (5) further presents the relationship between per-capita GDP and adult life satisfaction, which shows a clear contrast to the estimated coefficient for adolescent life satisfaction in column (1).[11]

[10] We distinguish Confucian and Non-Confucian countries in East Asia, given the much stronger educational competition in the former. Confucian societies include Korea, China, Taiwan, Japan, Vietnam, Hong Kong, and Macao.

[11] Data on adult life satisfaction was only available for 70 out of the 72 countries. When restricting the sample in column (1) to these 70 countries, the coefficient estimate for ln GDP per capita is similar (coeff. -0.360; s.e. 0.086).

Table 3 Per-capita GDP, Education, and Adolescent Life Satisfaction

	Life satisfaction					
	(1)	(2)	(3)	(4)	(5)	(6)
Ln GDP per capita	−0.425***	−0.441***	−0.195*	−0.525***	−0.233*	−0.0922
	(0.0916)	(0.0967)	(0.115)	(0.112)	(0.123)	(0.119)
PISA avg. test score (/100)			−0.493***		−0.531***	−0.396***
			(0.145)		(0.131)	(0.127)
Student competition			−0.987***		−0.842***	−0.737***
			(0.284)		(0.287)	(0.261)
Student co-operation			1.025***		0.983***	1.129***
			(0.300)		(0.297)	(0.325)
Adult life satisfaction				0.212**	0.159*	0.255**
				(0.103)	(0.0928)	(0.116)
Macro control variables						YES
Constant	11.61***	11.78***	11.52***	11.37***	11.13***	12.54***
	(0.948)	(1.004)	(0.888)	(0.894)	(0.837)	(1.442)
Observations	72	71	71	70	69	66
Adj. R-squared	0.211	0.214	0.412	0.190	0.411	0.488

OLS estimation. Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 3 presents the results of estimating Eq. (1) over a sample of up to 72 countries and for life satisfaction as dependent variable, stepwise adding control variables until the full model in column (6). Column (1) repeats the results from the first column of Table 2. Column (2) excludes Vietnam since no test scores have been published for Vietnam. In column (3), education-related variables were added to the model, and several observations can be made. First, the inclusion of education-related factors reduces the effect of per-capita GDP on adolescent life satisfaction by more than half, indicating that education indeed appears to be a key mechanism behind the negative impact of economic development on adolescent life satisfaction. Second, PISA test scores are negatively and statistically significantly related to adolescent life satisfaction in a country. An increase in PISA test scores by one standard deviation reduces adolescent life satisfaction by 0.259 (42 percent of a SD). Moreover, higher levels of competition among students are found to be negatively related to adolescent life satisfaction, while co-operation among students has a positive effect. A one-SD increase in student competition reduces life satisfaction by 0.242 (40 percent of a SD), while a one-SD increase in student co-operation raises life satisfaction by 0.222 (36 percent of a SD). Adding education variables raised the adjusted R^2 by 20 percentage points.

In columns (4) and (5), adult life satisfaction was added to the model to control for country-specific effects regarding the evaluation of one's life. This addition increases the effect of per-capita GDP, while confirming the education mechanism. Lastly, in column (6), macro control variables were added, which reduce the direct effect of per-capita GDP.[12] In summary, Tables 2 and 3 indicate a significant negative relationship between a

[12] We checked for the presence of multicollinearity among regressors of model (6) in Table 3. VIFs were all below 4. Interestingly, competition and co-operation showed a positive bivariate correlation, indicating that these can be complementing each other ($\rho=0.39$).

country's level of income and the well-being of its adolescents, a phenomenon that appears to be largely driven by education factors.

4.2 Robustness and Heterogeneity

To further examine our main findings, several robustness and heterogeneity checks were conducted. As for robustness checks, we examine potential selection effects from differences in missing values and in enrolment rates across countries. We further employ micro regressions to confirm the macro findings. Next, we re-estimate our main models using by-subject test scores instead of test scores averaged over all three subjects. We then examine the robustness of our findings to the inclusion of additional data from low and middle-income countries from PISA for Development. Lastly, we test for the heterogeneity of our findings with regard to student gender.

First, life satisfaction information was missing for 7.6 percent of students across the 72 countries under consideration. As can be seen from column (1) of Table 4, the share of missing values is negatively correlated with GDP per capita. In order to rule out any selection effects based on a systematic correlation of life satisfaction non-reporting with country income level, we re-estimated the relationship between per-capita GDP and adolescent life satisfaction in columns (3) to (5) for countries with less than 10 percent (5 percent, 3 percent) of missing values in life satisfaction. The estimates confirm the negative nexus between GDP per capita and life satisfaction; we even see that coefficients increase as we exclude countries with higher shares of missing values.

Second, one might be concerned that selection effects could bias the results of regressions in Table 3 if adolescents from poorer households were less likely to be enrolled in school at age 15 compared to their counterparts from richer households, and if socio-economic status affected adolescent well-being at the same time. This could affect our findings, since usually middle-income countries face lower secondary enrollment rates compared to high-income countries. Thus, to examine whether differences in enrollment rates might have influenced our findings, we added the lower secondary net enrollment rate to the model. Table 5 presents the results. Since enrollment rates were not available for all countries, columns (3) and (4) additionally use imputations to increase sample size.[13] Results presented in Table 5 show that even after controlling for differences in enrollment, our main findings remain unchanged.

In a third robustness check, we used individual life satisfaction (as opposed to the country average) as dependent variable and conducted micro regressions as laid out in Eq. (2). Micro regression results are presented in Table 6 and again confirm earlier macro findings about the negative relationship between per-capita GDP and adolescent life satisfaction. The role of learning intensity and the school environment is further reiterated. In particular, national averages of student test scores, of competition and of co-operation continue to show significant impacts on adolescent well-being. After controlling for education factors, the negative effect of per-capita GDP drops and even reverses from negative to positive

[13] Imputed values are predicted based on a multivariate regression of lower secondary net enrollment on ln GDP per capita, average and expected years of schooling for 2018 from the Human Development Index, as well as 10 world region dummies.

Table 4 Robustness—Missing values

	(1)	(2)	(3)	(4)	(5)
	Share of missing values in life satisfaction	Life satisfaction			
		All countries	< 0.10 missing values	< 0.05 missing values	< 0.03 missing values
Ln GDP per capita	−0.0261**	−0.425***	−0.545***	−0.504***	−0.625***
	(0.0118)	(0.0916)	(0.118)	(0.129)	(0.115)
Constant	0.346***	11.61***	12.85***	12.42***	13.50***
	(0.125)	(0.948)	(1.238)	(1.350)	(1.206)
Observations	72	72	53	33	13
R-squared	0.071	0.222	0.284	0.227	0.557

OLS estimation using PISA 2018 data. Robust standard errors in parentheses; ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 5 Robustness check—Enrollment

	Life satisfaction			
	(1)	(2)	(3)	(4)
Ln GDP per capita	−0.478***	−0.157	−0.510***	−0.139
	(0.103)	(0.147)	(0.100)	(0.134)
PISA national average test score (/100)		−0.439**		−0.451***
		(0.187)		(0.131)
Student competition		−0.750***		−0.690**
		(0.261)		(0.263)
Student co-operation		0.971**		1.123***
		(0.369)		(0.313)
Lower secondary net enrollment rate	0.0184	0.0145		
	(0.0112)	(0.0109)		
Lower secondary net enrollment rate (imputed)			0.0267**	0.0179
			(0.0110)	(0.0109)
Control variables		YES		YES
Constant	10.40***	11.07***	9.930***	11.54***
	(1.166)	(1.572)	(1.030)	(1.527)
Observations	61	58	70	66
Adj. R-squared	0.226	0.393	0.217	0.499

OLS estimation. Other control variables as in Table 3. Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$. The enrollment rate used in columns (3) and (4) replaced missing values with imputed values. Imputed values are predicted based on a multivariate regression of lower secondary net enrollment on ln GDP per capita, average and expected years of schooling for 2018 from the Human Development Index, as well as 10 world region dummies

(albeit with a small magnitude) in column (4) of Table 6. The effect turns negative again after adding adult life satisfaction, macro controls, and student-level controls to the model in column (5). School-level variables were added in column (6). These variables are *peer* averages of PISA test performance and perceived competition and co-operation among students. Adding these variables allows us to disentangle the roles of the school culture vs. the national education culture in their respective influences on student well-being. Column (6) results indicate that academic performance (PISA test scores) matter only at the school-level, suggesting that students compare their performance mainly with their direct peers. However, regarding perceived levels of student competition, the national level dominates the school level. Reassuringly, the latter confirms earlier research findings on nationally induced education competition on adolescent well-being (Ahn & Baek, 2012; Kuan, 2018). The full model is further estimated separately for students in middle-income vs. high-income countries (columns 7 and 8). Comparing coefficients suggests that the national education culture matters more strongly for adolescent well-being in middle-income countries compared to high-income countries. At the school level, there are only minor differences in coefficients. Nevertheless, one should be cautious with the interpretation of columns 7 and 8, given that the number of countries in each group is small and cultural differences between countries are likely to be larger within the group of middle-income countries. Table 6 further includes variables controlling for the importance of migration across

Table 6 Robustness check—Micro regressions

Dep. variable: life satisfaction								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All countries	Middle-income countries	High-income countries	All countries	All countries	All countries	Middle-income countries	High-income countries
Country-level variables								
Ln GDP per capita	−0.398***	−0.254***	−0.147***	0.0995***	−0.493***	−0.514***	−0.691***	0.324***
	(0.0219)	(0.0441)	(0.0549)	(0.0282)	(0.0436)	(0.0424)	(0.0559)	(0.0665)
PISA nat. avg. test score (/100)				−0.611***	−0.312***	−0.0357	−0.208***	−0.165***
				(0.0287)	(0.0293)	(0.0361)	(0.0662)	(0.0497)
Student competition (nat. avg.)				−0.670***	−1.046***	−1.099***	−3.445***	−0.344***
				(0.0548)	(0.0554)	(0.0732)	(0.175)	(0.0776)
Student co-operation (nat. avg.)				0.291***	1.269***	0.894***	1.518***	0.138
				(0.0615)	(0.0719)	(0.0797)	(0.129)	(0.0897)
Share of migrant students (nat. avg.)					−0.0617	0.429**	5.698***	0.217
					(0.176)	(0.205)	(0.672)	(0.209)
Adult life satisfaction					YES	YES	YES	YES
Macro controls					YES	YES	YES	YES
School-level variables								
PISA test score (/100) (peer avg.)						−0.288***	−0.379***	−0.155***
						(0.0253)	(0.0355)	(0.0321)
Student competition (peer avg.)						0.0505	0.0932	−0.0307
						(0.0492)	(0.0715)	(0.0607)
Student co-operation (peer avg.)						0.388***	0.392***	0.360***
						(0.0384)	(0.0502)	(0.0546)

Table 6 (continued)

Dep. variable: life satisfaction								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All countries	Middle-income countries	High-income countries	All countries	All countries	All countries	Middle-income countries	High-income countries
Share of migrant students (peer avg.)						−0.533***	0.753**	−0.450***
						(0.131)	(0.330)	(0.141)
Student-level controls					YES	YES	YES	YES
Observations	493,202	195,821	297,381	487,874	449,100	447,147	178,631	268,516
R-squared	0.010	0.002	0.000	0.018	0.052	0.056	0.066	0.056

OLS estimation. Standard errors (corrected for clustering at the school level) in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$. Student-level controls include dummies for sex, single child, migrant background, having an own room, having a desk to study at home, having a quiet place to study at home

Table 7 Heterogeneity analysis by sex

	Girls' life satisfaction		Boys' life satisfaction	
	(1)	(2)	(3)	(4)
Ln GDP per capita	−0.533***	−0.145	−0.316***	−0.0338
	(0.0861)	(0.121)	(0.106)	(0.132)
PISA national average test score (/100)		−0.475***		−0.321**
		(0.127)		(0.139)
Student competition		−0.779***		−0.699**
		(0.248)		(0.301)
Student co-operation		1.269***		0.984***
		(0.338)		(0.321)
Control variables		YES		YES
Constant	12.52***	13.81***	10.69***	11.29***
	(0.889)	(1.360)	(1.100)	(1.696)
Observations	72	66	72	66
Adj. R-squared	0.294	0.557	0.110	0.403

OLS estimation. Other control variables as in Table 3, column 6. Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$

countries and across schools. Results indicate a negative relationship between the share of students with migration background in school and adolescent life satisfaction.

Fourth, we examine whether averaging over test scores in reading, math, and science affects our results. Table 9 presents evidence of using by-subject test scores instead of test scores averaged over all three subjects. Column (1) shows the full model from the last column of Table 3, which uses test score averages over all three subjects. Columns (2) to (4) then use country averages in reading scores, math scores, and science scores one-by-one. Coefficient estimates and significance levels across all four models are found to be highly similar. This confirms the validity of the averaged test scores in our main models.

In a fifth check of robustness, we add data from seven low and middle-income countries collected under the program "PISA for Development" (PISA-D) between 2014 and 2016. Data is available for seven countries of which four are established middle-income countries (Ecuador, Guatemala, Honduras, Paraguay), and three were classified as low-income until recently (Cambodia, Senegal, Zambia). We added these countries to the scatter plots in Figs. 5 and 6 in the appendix (PISA-D countries indicated by green triangles). There are particularly high gaps in adolescent life satisfaction among the relatively lower income countries. While Cambodia (KHM) and Honduras (HND) show very high levels of life satisfaction, the Sub-Saharan countries (Senegal (SEN), Zambia (ZMB)) are significantly below the regression line. This is not surprising, given relatively higher extreme poverty rates in the latter two countries. Overall, the negative log-linear relationship is confirmed in Fig. 5. Figure 6 uses a quadratic specification for the best-fit line. It hints towards an inverted-U relationship once low-income countries are added. It can be reckoned that when adolescents lack the most basic needs of human existence (food, shelter, clean water and sanitation, absence from conflict), their satisfaction with life will be low. Once basic needs

are met, as is the case for most youths in middle-income countries, adolescents show high levels of satisfaction with their lives. Moving on to high-income countries, education intensity and school-related stress gradually grow to play more important roles in the lives of adolescents.

The effects of economic development and related education intensity may further differ by sex. Past literature has shown that girls and boys behave differently under competition. Boys were often found to outperform girls in competitive environments (Gneezy & Rustichini, 2004; Gneezy et al., 2003), although this might reverse in the very rare cases of matriarchal societies (Gneezy et al., 2009). Hence, a heterogeneity analysis was carried out and Table 7 presents the results of the estimations by sex. Comparing results for girls and boys, findings indicate that the negative effect of GDP per capita on girls is significantly stronger than that on boys. We further find girls being more sensitive to all three education-related factors (national academic performance, student competition, and student co-operation). Our findings are both in line with the studies of Gneezy and colleagues, and with past literature showing that girls' mental health is affected more strongly by higher learning intensity and school-related problems (McCarty et al., 2008; Quis, 2015; Quis & Reif, 2017). Our results suggest that the mental health of adolescent girls should receive special attention by policy makers in highly competitive education environments.

5 Discussion

Our study documents a negative relationship between per-capita GDP and adolescent life satisfaction for a sample of 72 high- and middle-income countries. This result contrasts the well-known positive relationship between country income level and adult life satisfaction. To the best of our knowledge, this paradoxical change of sign when focusing on adolescents instead of adults has never been documented before. The nature of our analysis is of course reduced-form in kind, such that we cannot identify with certainty the exact mechanism by which higher income levels reduce adolescent life satisfaction. However, reality of adolescent life as well as abundant empirical evidence suggest that school life and educational efforts must play a key role in this regard. And indeed: our results suggest that academic performance is important for the observed decline in adolescent life satisfaction. Encouraging this point of view, we find that education-related variables exert significant influence on adolescent life satisfaction—independently of the specific model. Moreover, the respective education-related coefficients show the expected signs in our regressions: PISA test scores and levels of student competition are consistently negative, and levels of student co-operation enter positively. It is interesting to note how, at the macro level, we find that average academic performance is negatively related to students' SWB, while earlier studies focusing on the link between individual performance and individual life satisfaction usually report a positive link (see Bücker et al., 2018, for a meta study). Note that this is not a contradiction. At the individual level, a student can improve her SWB by performing better in school than her peers. However, at the macro level, overall academic performance and competition within schools increase learning intensity and school-related stress for each student, reducing SWB for the group as a whole. We therefore argue that the

intensity of education—which increases with the level of economic development—is very likely to be the mechanism behind our findings.

Two main implications can be derived from our analysis. First, our results indicate that mental costs of education play an important role for the experienced utility of adolescents. Hence, we urgently suggest incorporating mental cost into any economic analysis of education that follows the standard cost—benefit approach. In this context, we would like to point out that a 'competitive' student has additional adverse impacts on his or her classmates because this student makes their learning environment more competitive (compare Kim et al., 2022a, 2022b). Hence, there is ground for negative externalities of education as opposed to the well-known social benefits thereof which constitutes the second implication of our analysis. Our results further imply that higher levels of co-operation among students are beneficial to adolescents and might therefore be a useful mechanism to counter the adverse effects of growing competition. Thus, we strongly suggest new educational policies that encourage co-operative learning environments and aim for student well-being as a prime goal of education alongside academic performance.

The aforementioned failure to unambiguously identify the exact pathway(s) underlying our results has to be viewed as the main limitation of our study. We have, however, produced several indications that education-related measures do play a key role in this regard. Furthermore, these indications are consistent with previous studies in the literature. As noted in Sect. 2, previous research has shown that schoolwork-related anxiety is adversely affecting students' life satisfaction (Marquez & Main, 2021; Steinmayr et al., 2016, 2018). We think that our results are closely related to this finding. In fact, the underlying mechanism might be one and the same. Higher 'learning intensity', increased 'schoolwork pressure and anxiety', as well as more 'condensed learning' could be different terms that originate from the same phenomenon: the packing of school curricula in high-income countries. Similarly, previous research on time use has shown that adolescents in high-income countries enjoy higher levels of autonomy (Rees & Main, 2015; Rees, 2017). It is conceivable that higher school performance requirements can lead to an increase in heteronomy. Whether—and if so to what extent—such an increase leads to a drop in life satisfaction below the level of middle-income countries cannot be conclusively clarified either. While these considerations delimit the validity of our work, they have immediate consequences for future research in this area. We hope that future research directly addresses the underlying pathways, and the roles school curricula play therein. Particularly, an in-depth comparison of school curricula across countries and over time could prove very useful and might lead to the possibility to conduct a valid mediation analysis. Future education assessments such as PISA should put a greater emphasis on student well-being and should include recently developed measures of mental effort/workload as developed by Krell (2017). Moreover, a greater availability of comparable education assessment data from low- and middle-income countries will hopefully allow for a more comprehensive analysis in the future.

Appendix

See Tables 8 and 9.

Table 8 Summary statistics (micro regressions)

	Mean	Std. Dev
Life satisfaction	7.10	2.63
Individual characteristics		
Sex (1 = female)	0.51	
Single child (1 = yes)	0.26	
Migrant background (1 = yes)	0.07	
Own room (1 = yes)	0.79	
Desk to study at home (1 = yes)	0.83	
Quiet place to study at home (1 = yes)	0.82	
School-level variables		
PISA test score (/100) (peer avg.)	4.53	0.78
Student competition (peer avg.)	0.10	0.38
Student co-operation (peer avg.)	− 0.01	0.40
Share of migrant students (peer avg.)	0.07	0.14
Country-level variables		
Ln GDP per capita	10.18	0.62
PISA nat. avg. test score (/100)	4.49	0.59
Student competition (nat. avg.)	0.10	0.24
Student co-operation (nat. avg.)	0.00	0.23
Share of migrant students (nat. avg.)	0.07	0.09
Adult life satisfaction	6.03	0.69
Life expectancy	76.74	3.95
Gini of hh income	0.47	0.11
Youth unemployment rate	14.57	8.18
Population density	4.40	1.04
Air pollution (PM 2.5)	19.06	13.64

N = 447,147. Summary statistics of PISA variables calculated using population weights

Table 9 Estimations using by-subject test scores

Dep. Variable: Life satisfaction (15-year-olds; country average)				
	(1)	(2)	(3)	(4)
Ln GDP per capita	−0.0922	−0.106	−0.0988	−0.0972
	(0.119)	(0.121)	(0.120)	(0.115)
PISA avg. test score (/100)	−0.396***			
	(0.127)			
PISA reading test score (/100)		−0.376***		
		(0.135)		
PISA math test score (/100)			−0.346***	
			(0.119)	
PISA science test score (/100)				−0.425***
				(0.126)
Student competition	−0.737***	−0.709***	−0.735***	−0.757***
	(0.261)	(0.260)	(0.265)	(0.258)
Student co-operation	1.129***	1.058***	1.181***	1.142***
	(0.325)	(0.318)	(0.335)	(0.320)
Adult life satisfaction	0.255**	0.274**	0.252**	0.248**
	(0.116)	(0.115)	(0.118)	(0.114)
Macro control variables	YES	YES	YES	YES
Constant	12.54***	12.74***	12.54***	12.58***
	(1.442)	(1.513)	(1.426)	(1.433)
Observations	66	65	66	66
R-squared	0.567	0.565	0.554	0.580

OLS estimation. Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.1$

See Figs. 3, 4, 5, and 6.

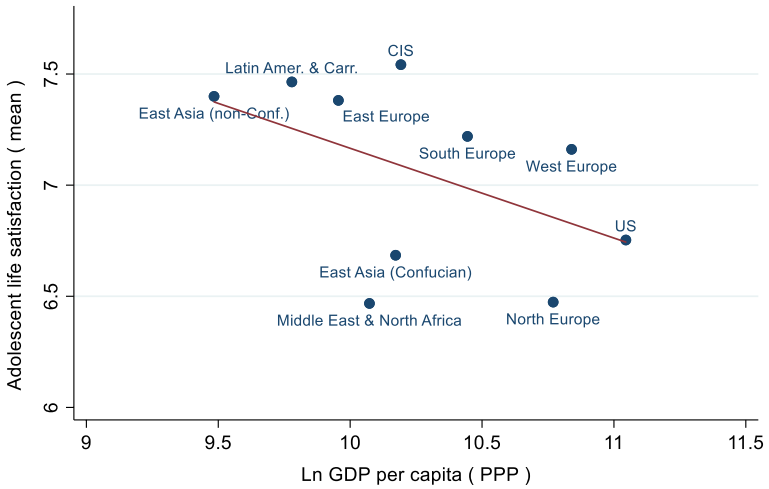

Fig. 3 Per-capita GDP and adolescent life satisfaction (by world region)

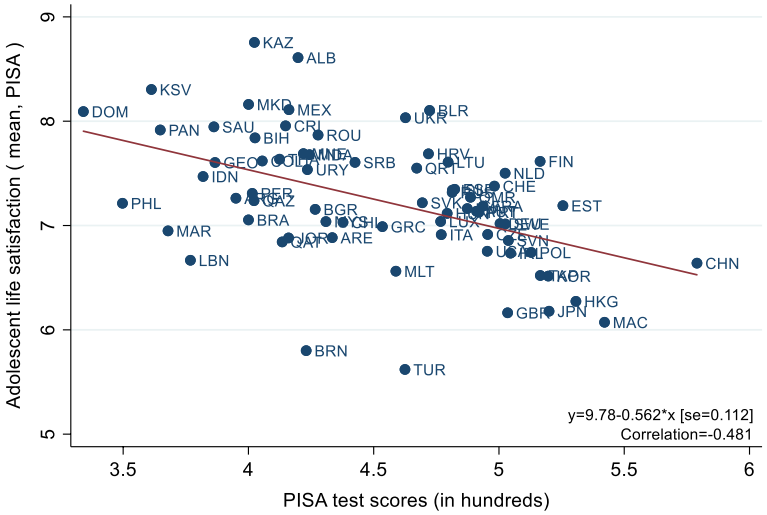

Fig. 4 Academic performance and adolescent life satisfaction

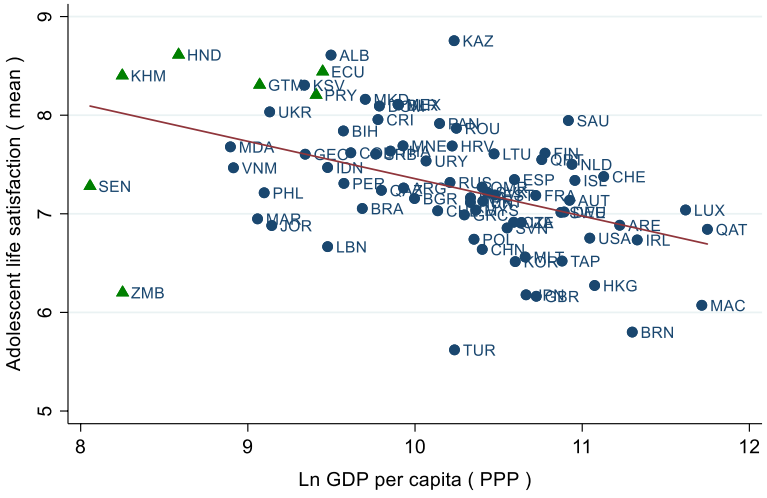

Fig. 5 Per-capita GDP and adolescent life satisfaction (including PISA for development countries)

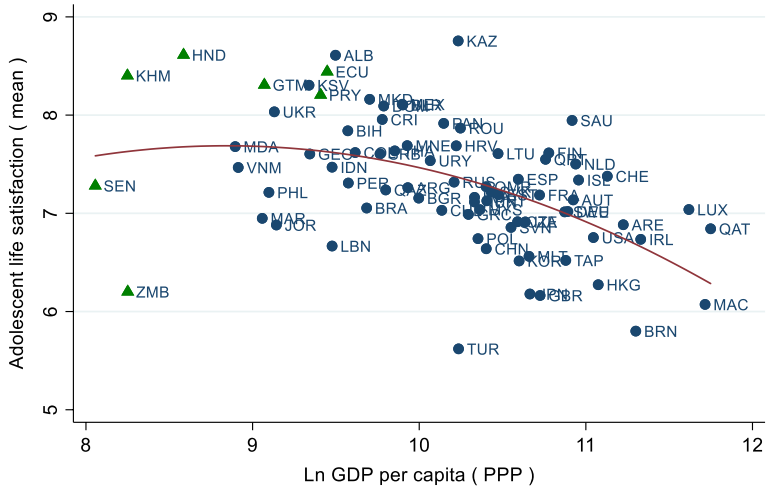

Fig. 6 Per-capita GDP and adolescent life satisfaction (quadratic fit), (including Pisa for development countries)

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