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Does teacher subjective well-being influence students' learning achievement? Evidence from public basic education in Peru

José María Rentería

Dante Solano

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Does teacher subjective well-being influence students' learning achievement? Evidence from public basic education in Peru

José María Rentería*

Dante Solano†

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Abstract

We estimate the influence of teacher subjective well-being (TSWB) on the mathematics learning achievement of public-school students in Peru. Using the National Teacher Survey and the Census Student Assessment, after exploratory and confirmatory factor analysis we identify three dimensions of TSWB: i) workplace relationships, ii) working conditions, and iii) living conditions. We estimate instrumental variables and perform quantile regressions to disentangle the relationship between TSWB and students' learning outcomes. Our results show that TSWB has an inverted U-shaped influence on test scores, suggesting the presence of the "too-much-of-a-good-thing effect", and therefore the existence of an optimal threshold after which its effect becomes detrimental. Workplace relationships appear to be the most influential TSWB factor on students' academic achievement.

Keywords: Teacher subjective well-being, learning achievement.
JEL classification: A12, C36, I21, I31.

*Corresponding author. PhD candidate in Economics at the University of Paris 1 Panthéon-Sorbonne, Centre d'Économie de la Sorbonne. E-mail: jose-maria.renteria-vasquez@etu.univ-paris1.fr

†PhD candidate in Politics and Development at the University of Leeds, School of Politics and International Studies. E-mail: pt18djss@leeds.ac.uk

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Resumen

El presente documento estima la influencia del bienestar subjetivo docente (TSWB) en los logros de aprendizaje de matemática por parte de estudiantes de escuelas públicas en Perú. Usando la Encuesta Nacional a Docentes (ENDO) y la Evaluación Censal de Estudiantes (ECE), los análisis factoriales exploratorio y confirmatorio permitieron identificar tres dimensiones del TSWB: i) relaciones laborales, ii) condiciones laborales y iii) condiciones de vida. A través de métodos de variables instrumentales y regresiones por cuantiles, buscamos desentrañar la relación entre TSWB y los logros de aprendizaje de los estudiantes. Los resultados muestran que el TSWB tiene una influencia en forma de U invertida en los puntajes de las pruebas, lo cual sugiere la presencia del efecto "demasiado de algo bueno" y, por tanto, la existencia de un umbral óptimo después del cual su influence se torna perjudicial. Las relaciones laborales parecen ser el factor del TSWB más influyente en el rendimiento académico de los estudiantes.
Keywords: Bienestar subjetivo docente, rendimiento escolar, aprendizajes.
Clasificación JEL: A12, C36, I21, I31.

1 Introduction

Teachers play a fundamental role in determining the quality of a school (Hanushek & Rivkin, 2006). It has been shown that they not only have a causal impact on student achievement during schooling but also have long-term effects on outcomes in adulthood (Chetty, Friedman, & Rockoff, 2014a, 2014b, 2017). However, several countries report serious concerns about attracting and maintaining an adequate supply of good quality teachers (OECD, 2005).

Evidence from behavioral science (mostly outside the educational realm) suggests a promising way of addressing these concerns, at least in part. Indeed, conditions of subjective well-being[1] seem not only to attract and retain talent but also to foster job performance and productivity (Erdogan, Bauer, Truxillo, & Mansfield, 2012; Harter, Schmidt, & Keyes, 2003). The relevant literature has usually explored broad subjective well-being variables such as life or job satisfaction (Caprara, Barbaranelli, Steca, & Malone, 2006). However, such an approach does not allow us to understand properly the relevant well-being concerns of individuals (Yamamoto, 2017). For this reason, some authors suggest giving more attention to needs or experiences at the individual level (Tay & Diener, 2011; Weiss & Rupp, 2011).

In adopting the latter approach, the objective of the present paper is twofold: it aims to identify the subjective well-being structure of basic public education teachers in Peru and to estimate its effect on students' mathematics learning achievement measured by standardized tests. To our knowledge, this is the first attempt in the literature to address these two issues together.

Any research focusing on the factors that influence student learning is challenging on conceptual, methodological, and empirical grounds. The reason is that a student's learning is influenced by a wide range of actors (including herself, her family, her classmates, her teachers, etc.) and also by a wide range of contextual circumstances (such as her school's organization and resources, curriculum structure and content, etc.) In our case, the challenge is double: we attempt to measure the impact of a latent variable, namely, teachers' subjective well-being, which is, in addition, suspected of endogeneity in the main equation. Indeed, it cannot be measured without error, and it may also be correlated with other omitted variables that configure the teacher's quality, but that cannot be measured or observed in the data. Moreover, we also suspect heterogeneous effects, which makes the identification even more challenging.

Our matter is of first interest because it has direct implications for educational policy. It points to the problem of achieving greater efficiency with feasible investment, focusing on a key agent of the educational process, namely, the teacher. If we show a significant effect of teacher subjective well-being on students' academic performance, a new variable with high potential for being influenced by policymakers will become available.[2] For instance, satisfaction with life or individual conditions could

[1] i.e. the cognitive-affective evaluations of their own lives that people carry out (Diener, Lucas, & Oishi, 2002).

[2] It is worth mentioning that, although what children bring to school (abilities, family back-

be included as indicators when recruiting and selecting teachers. Likewise, positive interventions for current teachers, such as personal and professional development, could be contemplated to improve their subjective well-being and thereby boost their effectiveness in the short term.

In relation to the existing literature, this paper offers three major contributions. First, it identifies the subjective well-being (SWB) structure of public sector teachers using an unusual and rich nation-wide representative sample. In the case of Peru, SWB has been analyzed by Yamamoto, Feijoo, and Lazarte (2008), Yamamoto (2014), and by Yamamoto (2017) from an emic perspective identifying the most relevant needs of this society, but there still is a gap in the literature when it comes to school teachers. Second, the present paper provides evidence on the relationship between teachers' subjective well-being and students' academic performance in a developing country. At the international level, evidence on this topic is still scarce, focused on high-income countries, based on small and selective samples (i.e. selected through convenience and purposive sampling), or not fully convincing in terms of causality (for a review, see Hascher & Waber, 2021). In addition, a part of the related literature studies only partially this relationship, since only one component of teacher subjective well-being (traditionally job satisfaction) is analyzed. In contrast, we consider a number of different facets of subjective well-being. Finally, this paper combines techniques borrowed from psychometrics and econometrics. Its interdisciplinary vocation -which locates it on the frontiers of Psychology, Economics, and Education- constitutes an advantage over other studies since the notions, concepts, and theories that will be mobilized to achieve the objectives will provide complementary insights.

To tackle our objectives accordingly, the empirical strategy relies mainly on the National Teacher Survey (ENDO)[3] 2016 and 2018, carried out by the Peruvian Ministry of Education.[4] This survey includes several items related to satisfaction with life and working conditions, and is representative of regular basic education teachers at the national level (urban and rural) in both private and public schools. Although its sample is made up of approximately 10,000 teachers in each edition, to obtain our subjective well-being measures aggregated at the school level we restrict the ENDO sample to primary and secondary public sector teachers (12,600 pooled observations approximately). In this way, we are able to match these data with school average scores in mathematics, obtained from the Census Student Assessments of 2016 and 2018 (which evaluate students enrolled in primary -2nd and 4th grades, and secondary -2nd grade). We complement this information with data from the School Census (2016 and 2017) to obtain our school characteristics variables,

ground, etc.) explains systematically the greatest variation in learning achievement, among "those variables which are potentially open to policy influence, factors involving teachers and teaching are the most important influences on student learning" (OECD, 2005, p.26).

[3]"Encuesta Nacional a Docentes de Instituciones Educativas Públicas y Privadas" - ENDO.

[4]Even though ENDO is a very rich survey (it has approximately 100 questions divided into 10 modules, including initial training, professional trajectory, economy, health, perception, among others), this survey has been little exploited by researchers, probably because of a lack of knowledge about its existence. Therefore, this study is a great opportunity to value a kind of survey that is not common anywhere in the world, especially among developing countries.

and the Poverty Map (2013 and 2017) for monetary poverty rates at the district level.

Based on the existing theoretical literature and empirical evidence, we propose a structure for teachers' subjective well-being which has three dimensions. They reflect teachers' satisfaction with their i) living conditions, ii) working conditions, and iii) relationships with colleagues. To validate this structure, we first proceed with an exploratory factor analysis on a random half subsample, which is afterwards more rigorously tested with confirmatory factor analysis on the other random half of the sample.

Next, we study the effect of teachers' subjective well-being on students' performance in standardized test scores. After discarding endogeneity, we perform quantile regressions to estimate heterogeneous effects across the distribution of the response variable.

The results suggest that the levels of teacher subjective well-being (TSWB) differ significantly between primary and secondary education, between teachers who chose their profession by vocation and those who did not, and between those who would and would not like to change their school district, among others. Likewise, TSWB appears to affect students' learning achievement in an inverted U-shaped form, suggesting the existence of an optimal threshold after which too much TSWB is detrimental.

Once the whole distribution is examined, it appears that TSWB does not significantly increase students' math scores in those schools where the average performance is very low, but its effect increases as the school performance does (at least in the first half of the distribution). TSWB factor 3 (working conditions) benefits only the best schools in terms of learning achievement. Finally, the most influential factor in students' scores is related to teachers' workplace relationships (TSWB factor 1). This could be an interesting variable for public policy to influence.

The rest of the paper is organized as follows. First, we present the current state of the art on the topic and the conceptual and theoretical framework that will guide this work (section 2). Then we describe the data (section 3) and the empirical strategy for testing the teacher subjective well-being structure, and its impact on students' learning achievement (section 4). Next, the main results are presented (section 5) followed by a series of robustness checks (section 6). The conclusions and a discussion of their policy implications close the document (section 7).

2 Conceptual framework

Subjective well-being (SWB) refers to the different evaluations that individuals make about their life experiences (Diener et al., 2017). Therefore, SWB includes the reflective cognitive judgments that people make about their life as a whole, or about specific domains such as health, work, or others (Diener, Oishi, & Tay, 2018). Diener et al. (2017) argue that the different facets of SWB can be measured through factor analysis and that a proper SWB assessment requires the measurement of several

facets. Furthermore, one may expect correlations between these facets themselves, and distinctive associations with other variables.

This framework is critical to the understanding of workers' SWB, which has been traditionally studied in the field of Organizational Psychology (Fisher, 2010; Harter et al., 2003). Conventionally, research on this area tackles SWB through job attitudes such as job satisfaction or commitment (Hulin & Judge, 2003). However, this literature has more recently started to pay more attention to workers' needs and experiences (Weiss & Rupp, 2011), including SWB facets beyond the workplace. In this regard, the relationship between life satisfaction and workers' well-being shows mutual influence (Ford, Cerasoli, Higgins, & Decesare, 2011). Besides, situational features and the working context are also relevant to SWB (Diener et al., 2017). More interestingly, both the workplace and life well-being are positively related to job performance and the attraction and retention of workers (Erdogan et al., 2012).

Empirical research suggests that life satisfaction and workplace well-being are related to different psychological, social, and economic features. Harter et al. (2003) performed a meta-analysis regarding SWB at work. Based on data collected from Gallup, they reviewed studies on twelve indicators which comprise principally relationships with peers and supervisors, working conditions, recognition, and perception of one's own performance. They found that these SWB indicators correlate with several business outcomes such as employee turnover reduction, and the improvement of rates of customer satisfaction, productivity, and profit.

Several authors have noted the importance of understanding the needs and experiences that are related to life satisfaction. Tay and Diener (2011) analyzed representative samples from 123 countries, finding that basic needs such as money for food and shelter are related to life satisfaction. Psychological needs such as relatedness and competence are also positively related to it (Church et al., 2013). Recently, Ngamaba (2017) found that perceptions of health, freedom of choice, trust, and financial satisfaction, are the main factors related to life satisfaction in 85 representative national samples collected by the World Values Survey. Evidence from Peru identifies similar emic indicators of subjective well-being, but grouped into four factors: feeling good about oneself, living in a good place, status, and family (Yamamoto, 2017).

In educational research, teachers' SWB is a concern that has received growing importance in the last few decades. However, a proper idea of teachers' SWB has been impossible, because the studies of it have relied on mutually incompatible frameworks and traditions. Most of the initial works were focused on negatives of well-being, such as burnout and stress. Contemporary studies have focused on understanding the structure of teachers' job attitudes (Renshaw, Long, & Cook, 2015; Van Horn, Taris, Schaufeli, & Schreurs, 2004), the role of life satisfaction on teachers (Duckworth, Quinn, & Seligman, 2009; Lee & Shin, 2017), and some interventions to promote teacher well-being, which can include features of mental and physical health (Hwang, Bartlett, Greben, & Hand, 2017). Furthermore, there is very little evidence on the relationship of teachers' SWB to student outcomes (Caprara et al., 2006; Duckworth et al., 2009; Hwang et al., 2017). Besides, this

little evidence has almost exclusively focused on developed countries.

Based on the current state of the art, we postulate that there are three relevant dimensions of teachers' subjective well-being, namely *satisfaction with* i) living conditions, ii) working conditions, iii) workplace relationships.

The first dimension aligns with life satisfaction, a critical aspect of subjective well-being (Diener, Inglehart, & Tay, 2013; Diener et al., 2018; Pavot & Diener, 2009). Emic research in Peru suggests that this component is related to satisfaction with one's health, self-esteem, family relationships, entertainment, and one's children's education (Yamamoto, 2017; Yamamoto et al., 2008).

The second dimension is related to job security and working conditions. Extensive evidence testifies to the relevance of these aspects to teachers' well-being (Lee & Shin, 2017; Toropova, Myrberg, & Johansson, 2021). It is to be expected that some aspects, such as satisfaction with salary (Currall, Towler, Judge, & Kohn, 2005), recognition of achievements (Shann, 1998), and conditions of retirement (Holochwost, DeMott, Buell, Yannetta, & Amsden, 2009), would be related to this dimension.

The third dimension is related to the interpersonal relationships that teachers develop in their workplace, which affect their subjective well-being (Lee & Shin, 2017; Van Horn et al., 2004; Zembylas & Papanastasiou, 2006). Thus, it is to be expected that relationships with colleagues and superiors play a significant role (Macuka, Burić, & Slišković, 2017). This dimension should also include satisfaction with other members of the educational community, since evidence suggests that relations with students (Roorda, Koomen, Spilt, & Oort, 2011; Spilt, Koomen, & Thijs, 2011) and also students' parents (Hoover-Dempsey, Bassler, & Brissie, 1992; Lasky, 2000) are relevant for teachers.

Even though these three dimensions are conceptually related to two different aspects of subjective well-being (life and work), the literature suggests that both are especially closely connected in the case of teachers (Day & Leitch, 2001; Renshaw et al., 2015). Therefore, all these dimensions align with the framework of subjective well-being. In section 4.1 we describe the empirical strategy that we used to test this structure, and in section 5.1 we present the results.

3 Data

The main source of information used in this study comes from the National Teacher Survey (ENDO) carried out by the Peruvian Ministry of Education. Although four editions are available (2014, 2016, 2018, and 2020), this paper reports the use of only the second and third waves. It should be noted that the last edition had a very different methodological approach (the survey was by phone) and asked fewer questions. At the same time, the scales of subjective well-being used in 2014 differ from those used in 2016 and 2018 (6 Likert-type response options were offered instead of 4). Therefore, we opted to focus on 2016 and 2018, which also had variables that were useful later as instruments (cf. section 4.2).

ENDO provides representative information on regular basic education teachers (preschool, primary, and secondary education) at the national level in both the private and public sectors.[5] For 2016, its sample was made up of roughly 9,800 teachers distributed over 3,000 schools; for 2018, the sample was around 15,000 teachers distributed over 4,500 schools. However, we made two important choices. We excluded private sector teachers because theirs is a very heterogeneous universe, with a wide array of motivations, conditions, origins, etc. (Díaz & Ñopo, 2016). More importantly, the private sector exhibits drastic differences in the quality of education provided, which is a function of the amount of fees charged (Minedu, 2018). In addition, private schools benefit from significant liberty for the nature of their educational provision, since the Ministry of Education provides only general guidelines for them. In contrast, public-sector teachers inhabit a sort of working-class in the Peruvian context. However, we also, as explained below, exclude preschool teachers, in order to provide a coherent match with the students' scores at the school level.

Even though ENDO is a very rich survey (it has approximately 100 questions divided into 10 modules[6]), it has been little exploited by researchers, probably because of a lack of knowledge about its existence. Therefore, this study is a great opportunity to evaluate a kind of survey that is uncommon anywhere in the world, especially among developing countries.

For the purposes of this paper, ENDO provided mainly the questions dealing with teachers' subjective well-being. These questions are of the form: "*Taking all things together, would you say you are...? (i) Not at all satisfied, (ii) A little satisfied, (iii) Satisfied, (iv) Very much satisfied*". Table 1 shows the dimensions included in ENDO's questionnaire.[7]

The main analysis of this paper, which is displayed in section 5.2, builds on aggregated data at the school level. However, to obtain school TSWB measures we must first work at the teacher level.

In this context, the sample for obtaining TSWB measures at the school level was made up of 12,661 teachers, almost equally distributed between primary and secondary school levels, as shown in Table B.1 in the Appendix. Likewise, the teachers working in urban schools tended to be older and to have permanent positions. These patterns are similar to those shown by other authors. (e.g. Díaz & Ñopo, 2016; Guadalupe, León, Rodríguez, & Vargas, 2017).

The teachers whom we surveyed are distributed among 3,720 clusters (per school-year), as shown in Table B.2. In more clusters than not (almost 6 out of 10), between one and three teachers were surveyed. As stated above, the objective was to work at the school level, since we had no identifier to match students' test scores

[5]It allows inferences with 95% confidence according to the level of education (initial, primary, secondary), geographical location (urban, rural), type of school (public, private), and region.

[6]Among those that stand out are questions on initial training, professional trajectory, the respondent's economic state, health, and perception.

[7]It is noteworthy that in 2018 a dimension (infrastructure and equipment of the school) was added that was not present in 2016. To ensure comparability, we exclude it from the analysis.

Table 1: National Teacher Survey: Items related to subjective-well being

	Taking all things together, would you say you are: not at all satisfied, a little satisfied, satisfied, or very much satisfied with...?
1	Your life
2	Your health status
3	Your job in your school
4	The education that you can provide to your children
5	Your future retirement conditions
6	Your self-esteem
7	Society's recognition towards your job as a teacher
8	Your relationship with your family
9	Your recreational activities
10	Your pedagogical activity
11	Your students' achievement and your relationship with them
12	The Ministry of Education's recognition of teachers
13	Your relationships with colleagues
14	Your relationship with the Principal
15	Your relationships with students' parents
16	Your school's location
17	Your salary
18	Your relationships with the community

Source: National Teacher Survey (2016, 2018), as elaborated by the present authors.

to particular teachers, only to schools. In this sense, the characteristics of the sample of schools are presented in Table B.3.

The second database is the Census Student Assessment (ECE[8]), which is a national standardized test administered by the Ministry of Education.[9] Depending on the year, the ECE is administered to second or fourth-grade primary students[10], and also to second-grade secondary students. Although it has evolved to greater diversity of subjects in secondary education, here, for the sake of comparability, we restricted the analysis to the results of mathematics tests alone. Likewise, we considered only the population in regular basic education in 2016 and 2018.

Using ECE, we calculated the pupils' mean score in mathematics tests for each school-year. Then we transformed them into z-scores (at the school level) and assigned these scores to each of the schools surveyed by ENDO.

Finally, we used the School Census 2016 and 2018 (Ministry of Education) to obtain

[8]Evaluación Censal de Estudiantes.

[9]ECE's statistical population was drawn from schools with at least five pupils enrolled in the targeting grade.

[10]In the case of fourth grade students, some years target regular basic education, intercultural bilingual education, or both.

characteristics at the school level (numbers of pupils and teachers, geographical location, among others), as well as the poverty maps for 2013 and 2018 (National Bureau of Statistics) to assign to each school the average poverty rate of its district in monetary terms. We also made use of the 2016 second ballot presidential election database (National Office of Electoral Processes), to obtain the proportion of voters at the district level for left- and right-wing parties. This variable was used as an instrument for SWB, as explained in the next section.

4 Methodology

4.1 Teacher subjective well-being

In this subsection, we describe the proceeding for assessing teacher subjective well-being based on the National Teacher Survey (ENDO). Here we present only the general guidelines, but in section 5.1 we provide all the detailed intermediate and final empirical results.

Table 1 presents the eighteen items of ENDO that ask about the level of satisfaction with different aspects of life and work. Based on the literature review, we suggested that these items can be grouped under three headings, as stated in section 2: satisfaction with (i) living conditions, (ii) working conditions, and (iii) workplace relationships. To validate this structure of teachers' subjective well-being, we followed the standard scale development procedures and recommendations stated in the recent literature (e.g. Cabrera-Nguyen, 2010; Graham et al., 2011; Renshaw et al., 2015). Specifically, after randomly splitting the sample into two subsamples, we proceeded as follows:

First, we performed an Exploratory Factor Analysis (EFA) with subsample 1, as a preliminary step to observing if the proposed latent variables emerged among ENDO's items (Fabrigar & Wegener, 2012; Goretzko, Pham, & Bühner, 2021).[11] We closely followed the modern evidence-based best practice procedures compiled by Watkins (2022).

We were dealing with ordinal data and therefore, we used polychoric correlations for building the covariance matrix. Moreover, since the item "not at all satisfied" was generally chosen by few respondents -as shown in Table 2- we merged it with the category "a little satisfied" to increase the precision of the estimation (DiStefano, Shi, & Morgan, 2021). Next, we conducted iterated principal factor extraction with initial communalities estimated by squared multiple correlations (Tabachnick & Fidell, 2019), because a maximum likelihood estimation would be sensitive to the nonnormal character of our data (Watkins, 2022, p.123).[12] We retained the factors based on parallel analysis, minimal average partials, and scree. Then we

[11] "The purpose of EFA is to explain as well as possible the correlations, or covariance, among measured variables (Sheskin, 2011). In EFA, measured variables are thought to correlate with each other due to underlying latent constructs called factors" (Watkins, 2022, p.69).

[12] Maximum likelihood is one of the most often recommended extraction methods for EFA, but it is not appropriate for our ordinal data (Fabrigar, MacCallum, Wegener, & Strahan, 1999; Field, 2013).

applied a Promax rotation (Cureton & Mulaik, 1975) because it allowed the factors to be correlated (Schmitt & Sass, 2011), which is consistent with the "ubiquity of intercorrelations among social science variables" (Watkins, 2022, p.126).

It should be mentioned that, as a first step, we removed items that (i) did not involve a clear statement about the satisfaction of a particular need among teachers, or (ii) that was designed to capture more general subjective dimensions of well-being (e.g. life, job). Then we removed items that had factor loadings below 0.3 after the rotation (Field, 2013) and looked at the alpha reliability of the scales (DeVellis, 2017).

Second, to test our theoretical three-dimension solution, we performed a Confirmatory Factor Analysis (CFA) (Brown, 2015) with subsample 2. The advantage of this approach was that it allowed us to make statistical inferences. We looked closely at the recommended indicators of model fit (Browne & Cudeck, 1992) before also analyzing the Cronbach Alpha to test the reliability of items for each dimension (Bland & Altman, 1997; Cronbach, 1951).

Finally, we tested the external validity of these dimensions by analyzing the correlation between the scores obtained in each of these latent variables (based on CFA) with other indicators also present in ENDO. This complied with two conditions: i) being also related to subjective well-being, and ii) not having been included in the previous steps. This kind of test is a common practice for validating psychometric constructs (Graham et al., 2011; Renshaw et al., 2015).

4.2 Assessing the impact of teacher subjective well-being on student academic performance

To assess the impact of teacher subjective well-being on student academic performance, we started with a simple OLS regression of the following form:

$$Y_s = SWB_{fs} + SWB_{fs}^2 + Y_{sb} + \mathbf{A}_s + \mathbf{B}_d + \mathbf{C}_s + \varepsilon_s \tag{1}$$

For each school s: Y_s is the average students' test z-score in school s, SWB_{fs} is the school s's score in the subjective well-being factor f, where $f \in [1, 3]$. Y_{sb} is the average test z-score, in school s, in baseline year b (2015), $\mathbf{A}_s$ is a vector of school characteristics: number of teachers, female teacher ratio, fixed-term teacher ratio, student-teacher ratio, number of educational areas. $\mathbf{B}_d$ is a vector of school's district d characteristics: poverty rate, rural, geographic domain. $\mathbf{C}_s$ controls for survey year and tested grade. Finally, ε_s is the usual error term.

It is worth mentioning that Y_{sb} can be considered exogenous, since it reflects the z-scores in a baseline year (2015), i.e. before the outcome under study (z-scores from 2016 and 2018). Y_{sb} is therefore independent of Y_s because it reflects the performance of an older cohort of students. The term Y_{sb} has particular relevance, for it controls omitted information that otherwise would be captured in the error term.

One may argue that there is reverse causality in Eq.(1), since students performing badly negatively affect TSWB, despite the fact that teachers are trained in dealing with such cases (because they are part of their profession). Taking an analogous situation, clinical psychologists are trained to deal with patients who have serious problems. Such cases are meant to have no influence on psychologists' personal lives -they have an adequate toolkit to distance themselves from them. Furthermore, evidence from the UK suggests that student achievement does not affect teachers' well-being (Kidger et al., 2016, p.79). In any case, to clear up any doubt about the endogeneity of the coefficients of SWB_{fs} and its quadratic form, we performed an augmented regression test, as suggested by Davidson and MacKinnon (1993), consisting of the following steps:

$$SWB_{fs} = \mathbf{Z}_{fs} + Y_{sb} + \mathbf{A}_s + \mathbf{B}_d + \mathbf{C}_s + \delta_s \tag{2}$$

$$SWB^2_{fs} = \mathbf{Z}^2_{fs} + Y_{sb} + \mathbf{A}_s + \mathbf{B}_d + \mathbf{C}_s + \gamma_s \tag{3}$$

$$Y_s = SWB_{fs} + SWB^2_{fs} + \hat{\delta}_s + \hat{\gamma}_s + Y_{sb} + \mathbf{A}_s + \mathbf{B}_d + \mathbf{C}_s + \gamma_s \tag{4}$$

First, Eq.(2) regresses the suspected endogenous variable SWB_{fs} on a vector of instruments $\mathbf{Z}_{fs}$, and all the exogenous variables from Eq.(1). Likewise, Eq.(3) does the same for the SWB quadratic term. As suggested by Wooldridge (2010), its instrument is the square of the original Z. In the final step, the residuals $R = \hat{\delta}_s + \hat{\gamma}_s$ are included in Eq.(1), as shown in Eq.(4). Subsequently, we tested the null hypothesis that R is equal to zero. If this hypothesis can not be rejected, we can plausibly state that SWB_{fs} is not endogenous.

4.2.1 The instruments

We used three sets of instruments to assess teacher subjective well-being:

a) Z1: commuting time

It is well established in the literature that commuting significantly contributes to the worker population's well-being, since it is a significant component of their daily activities (Chatterjee et al., 2020). People who live close to their work (or who commute for a relatively short time) show a greater propensity to declare better states of subjective well-being (Clark, Chatterjee, Martin, & Davis, 2020). Therefore, the distance (in minutes) between the teachers' homes and their schools was expected to have a direct impact on their subjective well-being. We claim that this distance is a good instrument because it also complies with the exclusion restriction. Indeed, one may argue that work productivity is independent of commuting because "commuting cost could be fully compensated by wage premiums or lower land rents, so the commuting would not influence job satisfaction and performance" (Ma & Ye, 2019, p.131). Wage premiums do exist in the Peruvian public educational system.

For example, if a school is in a rural area, the wage premium is a function of the school's distance from the provincial capital and the population of its catchment.

b) Z2: political preferences and voter turnout

In recent decades, political scientists and psychologists have suggested that political orientation influences subjective well-being. Napier and Jost (2008) find that right-wing individuals in the United States have higher happiness indicators than left-wing ones, as the former are less affected by economic inequalities, which is a critical aspect of left orientation (Bobbio, 1996; Jost, Glaser, Kruglanski, & Sulloway, 2003). Cross-cultural evidence suggests that this subjective well-being gap between left-wing and right-wing individuals is incremented by the levels of economic and social threat in a country (Onraet, Van Assche, Roets, Haesevoets, & Van Hiel, 2016). In addition, recent studies indicate that subjective well-being is an important aspect of political behavior; specifically, of vote turnover. Happier individuals tend to participate in the electoral process and be more engaged in politics (for a review, cf. Ward, 2019). Recent evidence also suggests that election outcomes have an impact on the life satisfaction of individuals (D. Gray, Pickard, & Munford, 2021). Therefore, political preferences and electoral outcomes influence the subjective well-being of individuals. For this research, we proxied political preferences and electoral behavior through two variables from the second ballot of the 2016 presidential election: both the proportion of voters in the right-wing party, and voter turnover, at the district level. There is no reason why either variable would directly affect pupils' learning achievement; they have nothing to do with children's educational outcomes.

c) Z3: school performance trend

The recent evolution of the school in terms of the outcome of interest may serve as an instrument. Indeed, if the school is continuously improving its performance in national standardized tests, it is an indicator that good things are happening inside the school and such optimistic evidence can positively affect teachers' SWB. More importantly, this variable complies with the exclusion restriction because it involves older cohorts of pupils, whose scores do not directly affect the scores of current students. We materialize this variable by taking the beta coefficient after regressing $y_{it} = \alpha_i + \beta_i time + \varepsilon_{it}$ for each school i and $time$ ranging from 2012 to 2016 (recoded in the sequence 1 to 5). It is worth noting that the main drawback of this instrument lies in the schools that were observed, for it requires schools to have been tested in the period of reference. Therefore, schools that had been created recently or were temporarily closed and did not take part in ECE evaluation had to be excluded from this approach. This explains the sample size reduction in the tables that are shown below. However, we consider that this variable, despite its limits, is pertinent and informative.

4.3 The effect on the whole students' scores distribution

To look more deeply at the effect of TSWB on the whole distribution of students' test scores, we decided to run quantile regressions. This choice was justified because it offered a much richer and more focused view than conventional models, which typically focus on the conditional mean of the response variable across the values of the predictors. Indeed, quantile regression "is capable of providing a more complete, more nuanced view of heterogeneous covariate effects" (Koenker, Chernozhukov, He, & Peng, 2018, p.xvii). This is the case because it estimates quantile-specific effects that describe the impact of covariates not only on the center but across the entire outcome distribution (Chernozhukov & Hansen, 2008, p.379). In this context, quantile regression is particularly appealing when the central and the tail quantiles are affected differently by the covariate of interest.

Following Wooldridge (2010), let $q(\tau)$ be the τth quantile of the distribution of y_i. Then, for $0 < \tau < 1$, it is verified that $P\left(y_i \leq q\left(\tau\right)\right) \geq \tau$ and $P\left(y_i \geq q\left(\tau\right)\right) \geq 1-\tau$. Assuming that the quantiles are linear in parameters, and writing the τth quantile of Y_s as , we have:

$$Quant_{\tau}\left(y_s|\mathbf{X}\right) = \alpha_0\left(\tau\right) + \mathbf{X}\beta_0\left(\tau\right) \tag{5}$$

Vector $\mathbf{X}$ includes all the right-hand variables of Eq.(1).

5 Results

5.1 Structure of teachers' subjective well-being

Following the procedure described in section 4.1, here we present the results validating the theoretical three-factor model of teacher subjective well-being previously proposed in section 2. As mentioned above, ENDO includes eighteen items that inquire about the level of teachers' satisfaction with different aspects of their life and work. Table 2 presents their distribution for our sample of interest, composed of 12,661 teachers.

Table 2: Public basic education teachers: Subjective well-being items (percentages)

	Satisfaction with...	Total	Not at all satisfied	A littlesatisfied	Satisfied	Very much satisfied
1	Life	100.00	0.44	6.03	53.29	40.23
2	Health	100.00	1.30	20.01	59.23	19.46
3	Job	100.00	1.08	14.04	61.94	22.94
4	One's children's education	100.00	1.38	20.25	55.85	22.52
5	Retirement conditions	100.00	31.80	46.43	18.09	3.68
6	Self-esteem	100.00	0.47	4.28	51.57	43.68
7	Society recognition	100.00	6.29	30.68	48.26	14.77
8	Family relationships	100.00	0.41	4.68	58.00	36.91
9	Recreational activities	100.00	4.86	25.07	55.38	14.69
10	Pedagogical activity	100.00	0.10	3.43	67.05	29.42
11	Students' achievement and one's relationship with them	100.00	0.11	5.07	63.78	31.04
12	MINEDU recognition	100.00	15.73	50.71	28.73	4.84
13	Relationships with colleagues	100.00	0.73	6.83	67.09	25.35
14	Relationship with the Principal	100.00	2.46	8.31	60.31	28.92
15	Relationships with students' parents	100.00	0.69	9.87	66.17	23.27
16	School location	100.00	4.01	20.50	57.23	18.26
17	Salary	100.00	24.45	56.99	16.59	1.98
18	Community relationships	100.00	0.78	8.89	73.64	16.68

Note: The total sample size is 12,661 individuals.
Source: ENDO 2016 and 2018. Authors' calculations.

To validate our three-factor solution, we took the following steps. First, we merged the categories "not at all satisfied" and "a little satisfied", since the former occurred as a response to very few of the questions (DiStefano et al., 2021). Second, we excluded item Nº1 (satisfaction with one's own life) because it is supposed to capture life satisfaction, which is a measure of subjective well-being that comprehends all kinds of experiences (Diener et al., 2013), not only those associated with work. Therefore, we preferred to use it later as a benchmark for checking consistency. Third, in the same way, item Nº3 (satisfaction with one's current job at school) was dismissed, since it evoked another construct of subjective well-being (Hulin & Judge, 2003). In a sense, this variable encompasses more refined aspects that we were already able to capture with other items related to a teacher's work and workplace. Finally, we also excluded item Nº 10 (satisfaction with pedagogical activity) because it is ambiguous. In a sense, it can be understood both as the teacher's job (its context) and as her performance at work (the effort entailed).[13]

After this preliminary proceeding, we verified that the subsample size ($n_1 = 6,340$) was large enough.[14] With fifteen items and three anticipated factors, there were five items per factor. This ratio required a sample of 500 to establish the internal validity of the scale (Rouquette & Falissard, 2011). Likewise, the ratio of individuals to variables was 422 to 1, which was adequate according to modern recommendations (Watkins, 2022). Therefore, for EFA our sample size was satisfactory.

We followed three guidelines for the number of factors to retain: parallel analysis (PA), minimal average partials (MPA), and scree (Watkins, 2022, p.124). For our case, PA suggested 2 factors, MPA 3 factors, and the scree plot 2 to 5 factors. Therefore, models with 5 to 2 factors were evaluated in sequence. The tables of results are displayed in Appendix C.

First, the five-factor solution had no salient items in its last factor: none had a loading above 0.32, which is the recommended threshold for salience (Norman & Streiner, 2014). Furthermore, its fourth factor had only two items. Experts, it should be noted, point out that at least three salient item loadings (pattern coefficients) are needed to form a factor (Watkins, 2022, p.156). Second, the four-factor solution showed a pattern that was close to our theoretical proposal. Factor 1 had salient items related to living conditions, factor 2 to relationships at the workplace, and factor 3 to working conditions. However, this solution revealed a 4th factor with the same caveats as the previous solution.[15] Since factor 4 was redundant in some ways, this solution was dismissed. Third, the two-factor solution was non-optimal because it mixed items related to living conditions with items related to the workplace. This solution lacks a theoretical or conceptual interpretation, which is a key element when implementing EFA (Flora, 2018).

[13] We confirmed that this item was problematic since it showed factor loadings in two factors for different solutions.

[14] As stated in section 4.1, we randomly split the sample into two subsamples. Subsample 1 was used for EFA, and subsample 2 for CFA.

[15] The two salient items in factor 4 were satisfaction with the teacher's relationships with colleagues and those with the Principal, which would correspond better to factor 2.

The three-factor solution converged properly, produced reasonable parameter estimates, and accounted for 47% of the total variance before rotation. The salient loadings were good in magnitude, and its structure was consistent with the theoretical solution proposed in section 2. Using the highest loadings for each factor after rotation, the ordinal alpha reliability (Viladrich, Angulo-Brunet, & Doval, 2017) was 0.82, 0.78, and 0.75 for factors 1, 2, and 3, respectively, which, as values, are acceptable to good.

Therefore, we can conclude that the results of EFA support the initial assumption that teachers' SWB in our sample is configured by three factors of satisfaction. The first factor, **satisfaction with workplace relationships**, was configured by indicators related to satisfaction with the teacher's peers, superiors, students, students' parents, and school location. At first sight, the latter variable seems to be out of place. However, a more careful consideration suggests that one's school location conditions or shapes the type of relationships that the teacher develops. Extensive evidence suggests that job relationships are critical for well-being in the workplace (Harter et al., 2003), including those in educational settings (Acton & Glasgow, 2015; Hascher & Waber, 2021; Spilt et al., 2011). The second factor, **satisfaction with living conditions**, is configured by self-esteem, family relations, health, recreation, and education for one's own children. Previous works based in Peru (although not focused on teachers) had already found in different samples that these indicators are related to subjective well-being (Yamamoto, 2017; Yamamoto et al., 2008). The third factor, **satisfaction with working conditions**, is composed of retirement conditions, wages, and the recognition by society and the Ministry of Education of the teaching profession. Monetary conditions have been a critical concern of teachers, as expressed in the most recent major strike (Vargas & Cuenca, 2018). They reflect status, just as recognition does.

Subsequently, we implemented a confirmatory factor analysis (Brown, 2015) with subsample 2 ($n_2 = 6,321$). The results were in line with the exploratory analysis, suggesting that the structure of teachers' well-being was made up of three factors: workplace relationships, living conditions, and working conditions. The model fit indicators ($\chi^2 = 2104.98$ / df =87, CFI = .904, NFI = .900, RMSEA = .060) suggest acceptable to good values[16], supporting our assumptions about the dimensions of teachers' well-being. The model represents the data and reflects the underlying theory. Its indicators are acceptable to good, but not excellent. This is understandable, since our model considers the broad dimensions of teachers' subjective well-being. The indicators of these dimensions cover different aspects of workplace relationships, living and working conditions. In this regard, the items' loadings in the different factor dimensions are also acceptable (cf. Appendix D), even if two of them are apparently low ($< .50$). In psychological research, these values for the goodness-of-fit indicators obtained from CFA were similar when scholars aimed to validate theoretical proposals that considered broad dimensions as part of their concepts, such as in our case.[17]

[16] cf. Hooper, Coughlan, and Mullen (2008, p.58) for the acceptable thresholds of the various fit indices.

[17] See, for instance, research on values (Schwartz & Boehnke, 2004) or morality (Graham et al.,

In the light of the results of EFA and CFA, the subjective well-being of Peruvian teachers may be summarized under three broad headings (dimensions). These dimensions are in line with the main literature, which suggests that relationships in the workplace (Harter et al., 2003) and living (Church et al., 2013; Yamamoto et al., 2008) and working conditions (Fisher, 2010; Harter et al., 2003) are critical for subjective well-being. These results contribute to expanding the evidence about a specific occupational group which is exposed to several stressors (C. Gray, Wilcox, & Nordstokke, 2017). In this regard, the results confirm that, in the case of teachers, the relationships with the school community, with students' parents, and with students themselves are relevant to their subjective well-being, in addition to the predictable relationships with peers and superiors. In the case of Peruvian teachers, who are on average 45 years old and have generally formed their own families, aspects such as children's education or family relationships are part of the evaluation of their satisfaction with life. This suggests a different approach to understanding subjective well-being, because most of these measures have individualistic indicators that do not necessarily consider family concerns (Yamamoto et al., 2008). Finally, the third dimension also suggests that society and government recognition are important aspects of a teacher's well-being. Moreover, these dimensions are closely interrelated, as our results suggest, which is also mentioned in the literature.

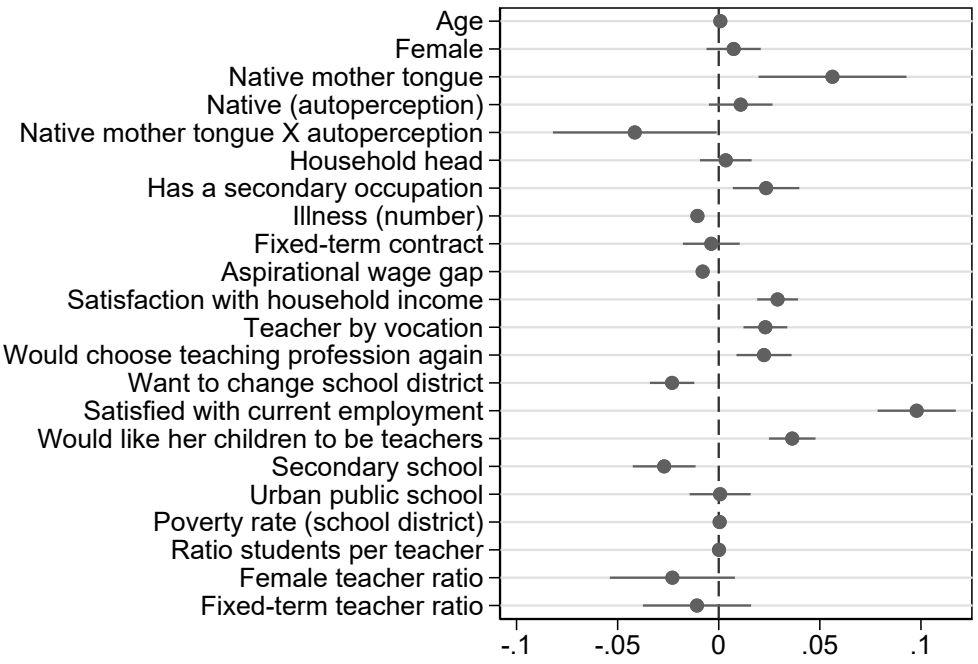
Having confirmed the structural form of TSWB, we can predict, for each teacher, her score for each TSWB factor. Larger values indicate higher levels of subjective well-being in the corresponding factor. Figure D.2 in the Appendix displays their distribution by means of box plots. By construction, they all have a mean virtually equal to zero. However, the TSWB factor 3 has the lowest variance (sd=0.229), while factor 2 has the highest (sd=0.289). This result is related to the concept of "happiness inequality", which refers to the extent that individuals differ in their reports of SWB in a given society (Goff, Helliwell, & Mayraz, 2018; Ward, 2019). Here, at least two important elements may be worth considering: the *reference effect*, i.e. the fact that individuals compare their situations or outcomes with other people's, and this affects, in turn, their SWB (Van Praag, 2011); and the *tunnel effect*, which arises when comparisons are taken as indicators of one's own future prospects (Hirschman & Rothschild, 1973). In our case, more individual differences in TSWB would be present in the second factor. Furthermore, factor 3 shows strong positive skewness, meaning that teachers are more satisfied in this TSWB dimension. In this context, a natural question arises: What determines the levels of the TSWB factors?

We address this question by regressing each TSWB factor on the covariates regarding teacher characteristics, school characteristics, and teachers' perceptions (cf. Appendix E). Here we discuss only the results for factor 1, since the conclusions are similar for the other factors. Figure 1 illustrates the coefficients for factor 1 shown in Table E.1. Concerning personal characteristics, an interesting finding is that the interaction term between native mother tongue and the self-perception of belonging to a native ethnic group shows a negative sign. This group of teachers probably have a feeling of discrimination or exclusion, which is consistent with the fact that

2011).

the indigenous condition in Peru is associated with lower levels of income and access to public services (Vakis, Rigolini, & Lucchetti, 2016). The opposite sign shown by both terms alone probably indicates that some teachers do not recognize themselves as indigenous. According to Flores and Sulmont (2021), the stigmatization of these groups in Latin American societies may explain the differences between the survey indicators of indigenous self-identification.

Figure 1: Distribution of the teacher subjective well-being factors (teacher level)



R-squared = .102
Source: National Teacher Survey and School Census, 2016-2018.

Among the variables under consideration, those in the model related to teachers' perceptions are particularly relevant. For example, more satisfaction with current employment significantly increases the score in TSWB factor 1. In the same way, those teachers who chose their profession because of their vocation (and not for other pragmatic reasons), those who would choose to be a teacher again if they had the opportunity to choose again, or those who like the prospect of their children's becoming teachers positively affect TSWB. These results might seem tautological, since our measures concern satisfaction with different aspects of life and work-related well-being. However, these results can be considered as indicators of external validity for our measures of subjective well-being. With respect to school characteristics, teaching in secondary education negatively affects the scores in factor 1 relative to primary education. This implies that primary and secondary levels pose different challenges to teachers, which is consistent, for example, with evidence from the UK that secondary teachers have lower subjective indicators of well-being than primary teachers (Scanlan & Savill-Smith, 2021).

5.2 Teacher subjective well-being and students' learning achievement

The distributions of our main variables (math z-scores and teachers' subjective well-being factors, both at the school level), are presented in Appendix F. By construction, they are normally distributed and show the expected behavior. TSWB factors display a very slight positive skew, and it is noteworthy that factor 1 has lower variance.

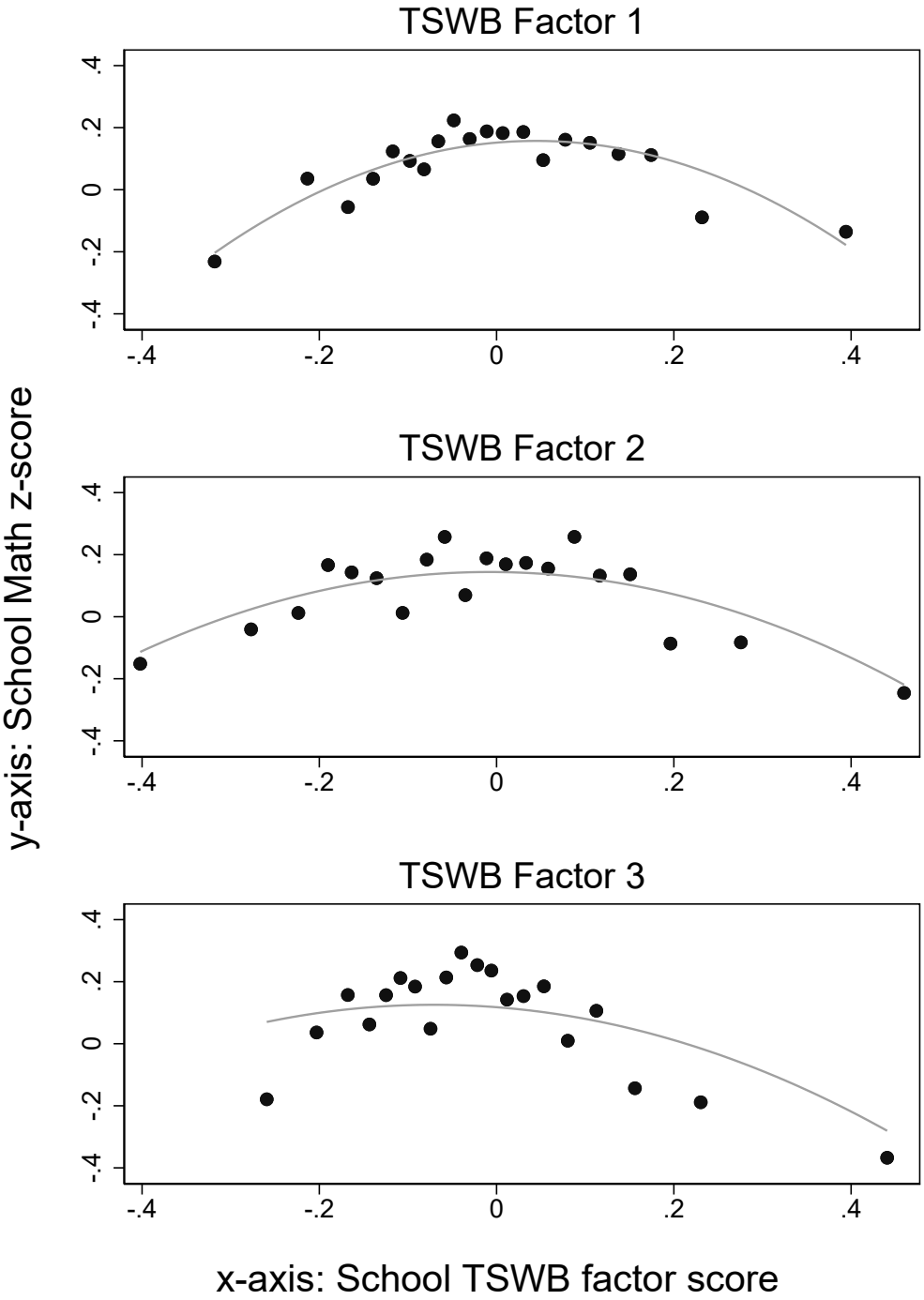
As a first descriptive approximation, Figure 2 presents non-parametric conditional expectation functions regarding the relationship between students' learning achievement and the TSWB factors. The curves show an inverted-U shaped pattern, meaning that there is a nonlinear relationship between our variables of interest. Students' z-scores increase with TSWB, but only up to a threshold beyond which they start to decrease. This kind of relationship is not uncommon when studying SWB or related topics: it is often the case that having only a little or having a great deal of something is not beneficial (Grant & Schwartz, 2011).[18] Speaking more generally, this issue is related to the meta-theoretical principle called the "too-much-of-a-good-thing effect" (Pierce & Aguinis, 2013), which occurs when "an initially positive relation between an antecedent and a desirable outcome variable turns negative when the underlying ordinarily beneficial antecedent is taken too far, such that the overall relation becomes nonmonotonic" (Busse, Mahlendorf, & Bode, 2016, p.131).

Let us now consider the OLS results. Appendix G presents two tables. The first shows the TSWB factors and their respective squared terms, controlling for the test performance of an older cohort in the baseline (2015), urbanity, poverty, and within-school context variables (teacher absenteeism in the previous year, number of teachers, female teacher ratio, fixed-term teacher ratio, student-teacher ratio, and number of school rooms), including in addition fixed-effects for the survey year, geographic domain, and student assessment grade. The second table shows the interactions between the TSWB factors, controlling for the same covariates as mentioned above.

The beta coefficients from Table G.1 related to TSWB factors are depicted in Figure 3. Each factor displays the expected sign with schools' average scores in math. That is, the greater the teacher SWB component, the higher the math score. The greatest impact is observed for TSWB factor 1. In contrast, the squared TSWB factors' term displays negative values, suggesting decreasing marginal effects, which confirms the first descriptive approximation previously shown in Figure 2. It is worth mentioning that only factor 1 shows statistical significance simultaneously for both the linear and the squared terms. Probably this fact suggests that TSWB factor 1 is the most important among the different TSWB dimensions for the educational context?

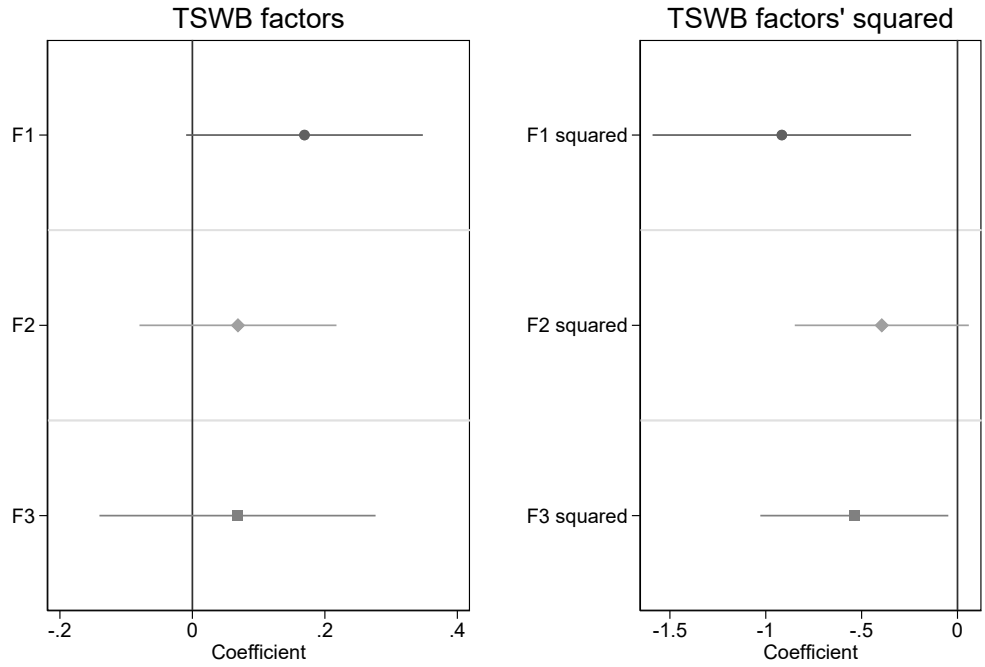
[18] For instance, recent evidence suggests that "whereas having too little time is indeed linked to lower subjective well-being caused by stress, having more time does not continually translate to greater subjective well-being. Having an abundance of discretionary time is sometimes even linked to lower subjective well-being because of a lacking sense of productivity" (Sharif, Mogilner, & Hershfield, 2021, p.1).

Figure 2: Students' learning achievement and teachers' subjective well-being factors: Non-parametric conditional expectation functions (school level)



Source: National Teacher Survey and Census Student Assessment, 2016 and 2018.

Figure 3: Beta coefficients for teachers' subjective well-being factors (OLS estimates, cf. Appendix G)



Source: National Teacher Survey and Student Census Assessment, 2016-2018.

When the three factors are studied together (Table G.2), the patterns are not so clear. Since, by construction, the three factors have non-negligible correlation levels[19], it seems that their relative importance competes and diminishes their effect. However, one interesting feature is that the interaction terms between factors (F1xF2, F1xF3, F2xF3) are positive (models 1 to 3). This means that there is a mutual influence in the same direction, especially between living conditions (F2) and working conditions (F3), which show consistent statistical significance (models 3 and 4). This finding is consistent with the literature, showing that life satisfaction can boost job satisfaction (Diener & Tay, 2017), which in turn can improve performance (Erdogan et al., 2012; Ford et al., 2011).

All in all, the OLS models explain almost half of the total variance. Schools located in urban areas and with higher female teacher ratios positively affect the z-scores. Inversely, schools located in poorer districts and with higher fixed-term teacher ratios show poorer z-scores in math (although their coefficients are not significant). In this line, extensive evidence suggests that economic and social conditions have an impact on subjective well-being: more difficult conditions increment psychological distress (Rojas, 2011).

We suspected that the teachers' subjective well-being factors may be endogenous. Therefore, we tested for this, using instrumental variables.

[19] At the school level, $\hat{\delta}_{F1,F2} = 0.81$, $\hat{\delta}_{F1,F3} = 0.69$, and $\hat{\delta}_{F2,F3} = 0.80$.

The first step is shown in Appendix H. Each table corresponds to a particular TSWB factor, as stated in Eq.(2). We use the three sets of instruments discussed in subsection 4.2.1. Since our instrumented variables have a non-linear term in the main model, we included in the Z vector the quadratic terms of the instruments, following Wooldridge (2010). The specifications were able to explain around 9% of the total variance, changing slightly with the endogenous variable and instrument set under consideration.

Next, for each TSWB factor we performed Wooldridge (1995)'s robust score test for endogeneity. The results suggested that the TSWB factors were not exogenous, since we could not reject the null hypothesis (cf. Table 3).

Table 3: Teacher subjective well-being factors: Test for endogeneity, by instrument set (H0: Variables are exogenous)

TSWB	Z set	p-value	F-statistic
Factor 1			
	Z1	0.095	2.359
	Z2	0.016	4.147
	Z3	0.000	15.324
Factor 2			
	Z1	0.000	15.324
	Z2	0.073	2.620
	Z3	0.000	15.474
Factor 3			
	Z1	0.019	3.985
	Z2	0.000	15.474
	Z3	0.000	15.667

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

The IV second-stage results are depicted in Tables 4, 5, and 6, for each TSWB factor in turn. There are at least three findings to highlight. First, the signs for the linear and quadratic terms in each TSWB factor display the expected behavior. There are only two exceptions: F1-squared and F2-squared, both under Z1. Second, the coefficients are systematically higher than the OLS estimates previously shown in Appendix G, regardless of the Z-set under consideration. This evidence strongly suggests that the OLS estimates were downward biased, that is, they underestimated the influence of TSWB on students' learning achievement. Finally, the IV coefficients were very high and their magnitude had a wide range. This may suggest that the populations that verified the relationships that our instruments were intended to capture were probably particular. Indeed, it should be recalled that the IV framework provides a local average treatment effect, and we cannot therefore generalize its results to the whole population of interest. However, although we are calculating effects for different complier subpopulations because of the three different Z-sets, the conclusions point to the same direction: TSWB has

an inverted U-shaped effect on pupils' learning achievement, and OLS estimates are plausibly downward biased.

The conclusions drawn about the OLS estimates were only *on average*; more precisely, the effect was on the mean of schools' z-scores distribution in math (controlling for the covariates mentioned in section 4.2). What would happen if we looked in more detail at the whole distribution of pupils' scores?

To answer this question, we ran three quantile regression models, each with one TSWB factor as the main explanatory variable.[20] Since quantile regressions are informative about the heterogeneous effect of the variable of interest across the distribution of the outcome, we were able to disentangle the effects of the TSWB factors across the distribution of pupils' scores in mathematics. Figure 4 shows the results.[21]

This figure suggests that TSWB factors have differential effects across the distribution of schools' z-scores. Schools with the weakest test performance benefit from TSWB factor 1. That is, the better the teachers' relationships at school, the better the pupils' performance in math tests. However, TSWB factors 2 and 3 seem to be innocuous with regard to pupils' learning achievement in school. Another finding from this figure is that TSWB factor 3 has almost no effect for the first half of the distribution of schools' z-scores.

6 Robustness checks

6.1 Alternative measures

As a first robustness check, we used different empirical definitions of teacher subjective well-being. First, we used the simple question that captures life satisfaction: "Taking all things together, would you say you are not at all satisfied, a little satisfied, satisfied, or very much satisfied with your life?". Certainly, this question covers a very wide area and implies a loss of the distinction between the different components of TSWB. However, life satisfaction is expected to be correlated with our measures, and therefore is a good proxy. Second, we used the first component predicted score of a principal component analysis. Again, we lost specificity in terms of the TSWB dimensions, but this measure can still be considered a conceptually meaningful one. Finally, we used the simple items average for each of the three factors that we proposed in our main analysis. The results are displayed in Table 7. It is immediately obvious that the five linear terms are positive, while their quadratic terms are negative, just as expected. Statistical significance is observed for our second, third, and fifth alternative TSWB measures, but the conclusions they point to are in the same direction.

[20] Admittedly, the TSWB factors are endogenous, but it is nevertheless a useful exercise to examine in this way the tendencies of the effects across the whole distribution.

[21] The coefficients for selected deciles are presented in Appendix I.

Table 4: 2SLS estimates - Dep. variable: School z-score in math

	(1) Z1	(2) Z2	(3) Z3
F1	2.120**	4.635	11.561*
	(1.037)	(3.408)	(6.403)
F1 squared	0.077	-17.502*	-39.290
	(8.265)	(9.745)	(28.782)
Math z-score in 2015	0.448***	0.387***	0.192
	(0.029)	(0.076)	(0.161)
Urban public school	0.209	-0.015	-0.232
	(0.137)	(0.139)	(0.409)
Poverty rate	-0.171	-0.141	-0.067
	(0.113)	(0.167)	(0.401)
Absenteeism in the previous year (days per month)	0.022	0.007	-0.006
	(0.037)	(0.042)	(0.084)
Number of teachers	0.001	-0.001	-0.002
	(0.001)	(0.002)	(0.005)
Female teacher ratio	0.574***	0.715***	1.280**
	(0.114)	(0.254)	(0.564)
Fixed-term teacher ratio	-0.120	-0.014	0.376
	(0.088)	(0.120)	(0.385)
Student-teacher ratio	-0.004	-0.005	-0.013
	(0.004)	(0.006)	(0.012)
Number of rooms	0.003***	0.003**	0.001
	(0.001)	(0.001)	(0.003)
N	3,215	3,208	2,612
chi2	2,030	847	148
RMSE			

Note: Controls include survey year and student assessment grade.

Source: National Teacher Survey and Student

Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: 2SLS estimates - Dep. variable: School z-score in math

	(1) Z1	(2) Z2	(3) Z3
F2	2.298*	5.987	10.072
	(1.270)	(6.288)	(7.298)
F2 squared	1.124	-13.780	-39.194
	(7.476)	(11.757)	(34.613)
Math z-score in 2015	0.465***	0.389***	0.227
	(0.032)	(0.102)	(0.178)
Urban public school	0.209	-0.082	-0.607
	(0.163)	(0.224)	(0.724)
Poverty rate	-0.152	0.039	0.447
	(0.147)	(0.280)	(0.750)
Absenteeism in the previous year (days per month)	0.004	0.022	0.015
	(0.033)	(0.053)	(0.099)
Number of teachers	0.001	-0.003	-0.008
	(0.002)	(0.004)	(0.011)
Female teacher ratio	0.650***	0.964*	1.375*
	(0.153)	(0.578)	(0.796)
Fixed-term teacher ratio	-0.176	-0.080	0.578
	(0.124)	(0.174)	(0.625)
Student-teacher ratio	-0.003	-0.002	0.007
	(0.005)	(0.007)	(0.017)
Number of rooms	0.004***	0.003*	0.001
	(0.001)	(0.002)	(0.004)
N	3,215	3,208	2,612
chi2	1,630	413	76
RMSE			

Note: Controls include survey year and student assessment grade.

Source: National Teacher Survey and Student

Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: 2SLS estimates - Dep. variable: School z-score in math

	(1) Z1	(2) Z2	(3) Z3
F3	3.223*	25.925	15.067*
	(1.829)	(59.959)	(8.145)
F3 squared	-5.707	-45.198	-28.807
	(7.868)	(100.005)	(21.611)
Math z-score in 2015	0.454***	0.231	0.309***
	(0.035)	(0.597)	(0.105)
Urban public school	0.139	-0.099	0.002
	(0.113)	(0.609)	(0.279)
Poverty rate	-0.252**	-0.967	-0.449
	(0.127)	(1.992)	(0.457)
Absenteeism in the previous year (days per month)	0.030	0.204	0.133
	(0.053)	(0.472)	(0.146)
Number of teachers	0.000	-0.007	-0.002
	(0.001)	(0.018)	(0.005)
Female teacher ratio	0.551***	1.307	0.929**
	(0.126)	(2.106)	(0.383)
Fixed-term teacher ratio	-0.139	-0.385	0.096
	(0.129)	(0.822)	(0.372)
Student-teacher ratio	-0.001	-0.012	-0.004
	(0.004)	(0.034)	(0.012)
Number of rooms	0.004***	0.008	0.006*
	(0.001)	(0.013)	(0.003)
N	3,215	3,208	2,612
chi2	1,769	69	141
RMSE			

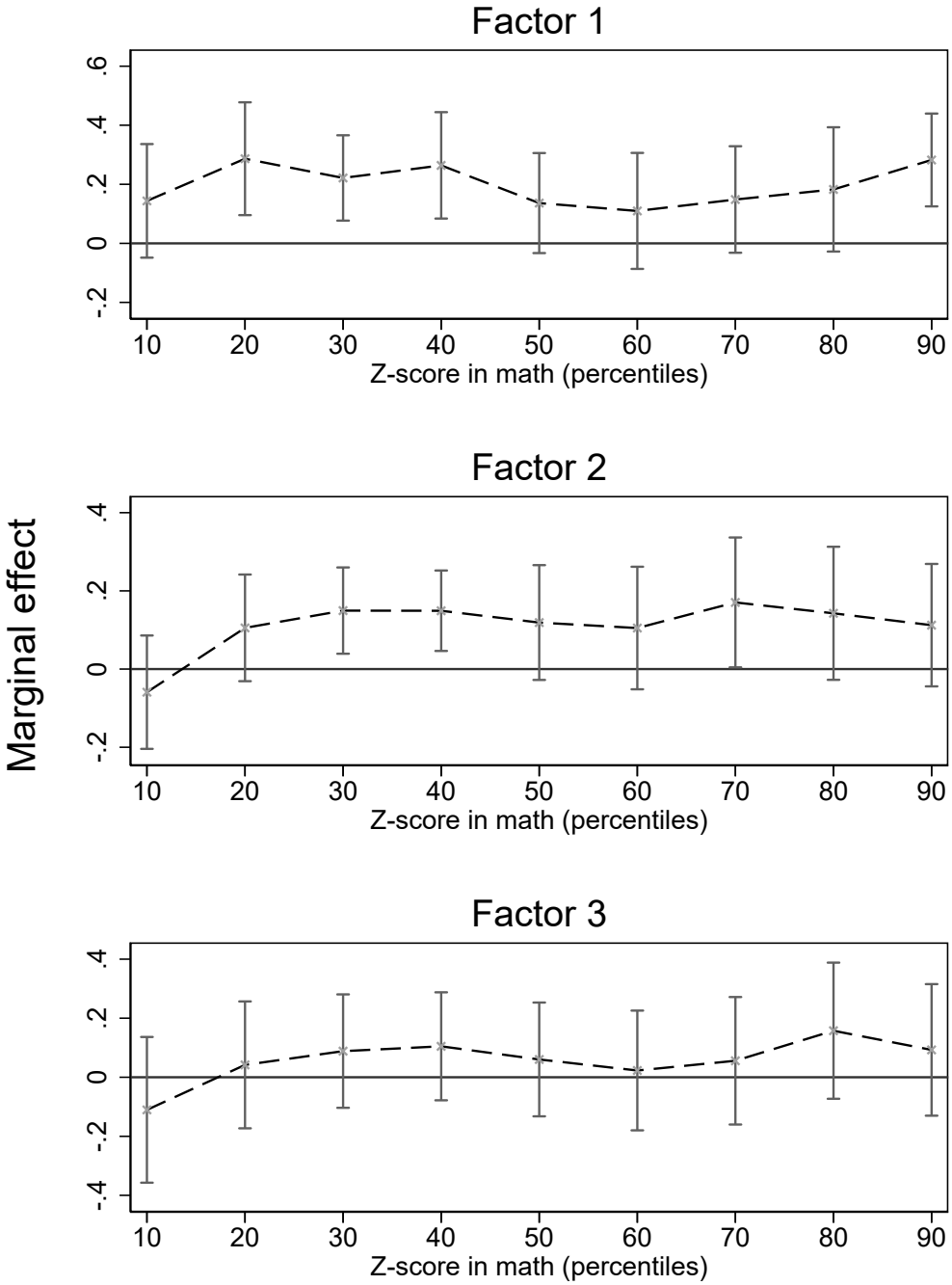
Note: Controls include survey year and student assessment grade.

Source: National Teacher Survey and Student

Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 4: TSWB factors marginal effect from quantile regressions



Note: Confidence intervals at the 95% level.
Source: National Teacher Survey and Student Census Assessment, 2016-2018.

Table 7: OLS estimates (alternative measures of TSWB) - Dep. variable: School average score in math

	(1)	(2)	(3)	(4)	(5)
Life satisfaction	0.446				
	(0.356)				
Life satisfaction squared	-0.082				
	(0.077)				
PCA score (component 1)		0.052**			
		(0.022)			
PCA score (component 1) squared		-0.043**			
		(0.021)			
Mean F1 items			1.463**		
			(0.628)		
Mean F1 items squared			-0.312**		
			(0.144)		
Mean F2 items				0.652	
				(0.527)	
Mean F2 items squared				-0.149	
				(0.124)	
Mean F3 items					0.488*
					(0.288)
Mean F3 items squared					-0.166*
					(0.088)
N	3,215	3,215	3,215	3,215	3,215
r2	0.493	0.494	0.494	0.492	0.493
F	140.60	143.23	140.71	140.24	141.66

Note: All regressions include the covariates and controls as in Table G.1.

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Pseudo-panel analysis

ENDO was not designed as a panel survey. However, a number of schools appear in the sample of different editions. Fewer than 200 schools were surveyed in both 2016 and 2018. By building a pseudo-panel of repeated cross-sectional surveyed schools, we exploited this temporal dimension in order to test the robustness of our findings. Let us consider the following fixed-effects model:

$$y_{it} = \alpha_i + \beta_1 SWB_{it} + \beta_2 SWB_{it}^2 + \gamma \mathbf{X}_{it} + \mu_{it} \tag{6}$$

where each school i is observed in two years t: 2016 and 2018. y_{it} denotes the school z-score in math in year t, $\mathbf{X}_{it}$ is a vector of school time-varying characteristics, and α_i represents school-specific intercepts that capture heterogeneities across schools.

We ran this model separately for two outcomes: the math z-score in the 4th primary schools and the 2nd secondary schools. The numbers of schools were, respectively, 79 and 110. Since these numbers were modest, we had to be careful in drawing conclusions.

The results are presented in Appendix J. It is interesting to note that, despite the small sample size, all the TSWB factors' coefficients display the expected sign, except for the quadratic term of F1 for the 2nd-secondary schools and F2 for the 4th-primary schools. The linear terms of the three TSWB factors were significant at the 1% level for the primary sample. The results are not conclusive, but they tentatively suggest a non-linear relationship, as well as the pertinence of the TSWB to pupils' learning achievement.

7 Conclusions

Few studies have been interested in measuring teachers' subjective well-being (TSWB) and its influence on students' outcomes. When teacher-related variables are taken into account in the literature, they are usually directly observed or measured; examples are pupil-teacher ratios, teachers' education, years of experience, or wages (e.g. Todd & Wolpin, 2007). As a consequence, the present paper research deserves attention not only because of the topic but also because its evidence from developing countries is still very scarce.

In this context, we first proposed a structure for TSWB based on items from the National Teacher Survey, using a representative sample of public basic education teachers. The structure considered three dimensions that were afterward validated by exploratory and confirmatory factor analysis: i) living conditions, ii) working conditions, and iii) workplace relationships. Our results expand the current literature by establishing that the well-being of teachers involves not only personal aspects but also facets of their workplace; they should therefore be borne in mind by future researchers.

Next, based on an analysis at the school level, OLS regressions show that TSWB significantly increases students' math scores according to an inverted-U shaped form,

suggesting the existence of a threshold after which its effect becomes less beneficial. In other words, we are in the presence of a "too-much-of-a-good-thing effect" (Pierce & Aguinis, 2013). Furthermore, quantile regressions show that the workplace relationships dimension is beneficial for those schools where the average math performance is very poor. The effect of the three TSWB factors increases as the school performance does, at least for the first half of the math distribution. In other words, the effect of TSWB is more relevant when the average learning achievement is low (but not too low), implying that other elements are also important in such contexts. This is true at the school level, but may also be true at the classroom level. This perspective could be an interesting starting-point for future research.

Our results question the belief according to which happy workers are always systematically more productive. While most of the research on this topic has been done at the individual level (Judge & Kammeyer-Mueller, 2011), this paper, in contrast, adopts an approach at the school level. In this sense, our findings could be conditioned by the conceptualization of well-being and the presence of mediating and moderating variables (García-Buades, Peiró, Montañez-Juan, Kozusznik, & Ortiz-Bonnín, 2020; Whitman, Van Rooy, & Viswesvaran, 2010).

Our conceptualization of well-being differs from that in the traditional literature, which is usually more focused on job attitudes. By focusing on teachers' satisfaction at the school level, and the way in which their different living and working conditions affect their job performance, we observe that these variables have a non-linear relationship. To establish this, we also considered time-lagged student achievement results (our measure of teacher performance), following recommendations in the recent literature (García-Buades et al., 2020). However, the presence of mediating or moderating variables was not addressed here; this is a topic that needs to be scrutinized in future research.

Another aspect to further explore is related to the managerial practices in the schools. In Peru, effective schools are highly influenced by the managerial skills of the principal and deputy directors; they promote teacher collaboration, positive relationships between peers, and regular teacher training (León, Guerrero, Cueto, & Glewwe, 2021). Furthermore, a point that needs more attention is that at the organizational level it may be possible to verify whether student achievement impacts on teachers' well-being, even though previous evidence at the individual level suggests that it does not (Kidger et al., 2016).

In this context, it is important to acknowledge that "ability gaps in both cognitive and noncognitive skills across individuals and across socioeconomic groups open up at early ages" (Cunha, Heckman, Lochner, & Masterov, 2006, p.800). However, the present paper shows that TSWB can help to reduce the former gaps at least. Our findings support the idea that TSWB may be for policymakers a variable with a high potential to exert influence. In fact, the factor "workplace relationships" appeared to be the most influential of the three subjective factors, which is consistent with organizational and educational literature showing that positive relationships in the workplace boost performance (Harter et al., 2003; Hascher & Waber, 2021). Positive interventions for improving current teachers' relationships, including personal

and professional development, and managerial skills for school principals, could be considered to improve teachers' subjective well-being and thereby boost their effectiveness in the short term.

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Appendices

A Peruvian teachers' labor conditions

In 2012, the Peruvian Congress approved the Law of Magisterium Reform which establishes the current labor conditions of teachers in public schools. According to this Law, teachers in the public sector can be hired through two different types of work contracts. In the first, they are contracted by the government to work at a particular school for an academic year. They are usually called contracted to public services teachers ("docentes contratados")[22], who have a regime of 30 working hours per month and their base salary is S/ 2,400.30 soles (around US$ 686 in 2020). These teachers can obtain monetary bonuses depending on the type and geographical location of their working school. In addition, this type of contract can be extended for another year. Usually, these positions are opened when the local administrations cannot guarantee enough teachers for the educational service provision. In 2016, according to the National Council of Education[23], there were around 152,804 contracted teachers out of 396,771 in basic education.

In the second type of contract, teachers are hired in a permanent position ("docentes nombrados") .[24] Under this regime, there are eight remuneration scales which go from S/ 2,400.30 – S/ 3,200.40 soles (US$ 686 – US$ 914) according to the number of working hours per month, 30 to 40 hours respectively. To advance on these scales, teachers must pass other national evaluations and complete several years in the service. At the top of their remuneration scale, they can receive a salary of up to S/ 5,040.63 – S/ 6,720.84 soles (US$ 1,440 – US$ 1,920). These teachers can also obtain bonuses based on their schools' geographic or special academic conditions, and also for assuming a managerial position in a school. In 2016, the National Education Council suggested that there were around 226 307 permanent teachers, 86.4% of which were on the first three scales of remuneration.

Both types of teacher are recruited through a national decentralized process of evaluation implemented by the Peruvian government. At the beginning of this process, the Ministry of Education (MINEDU) establishes a number of positions that will be opened in each Local Administrative Education Unit ("Unidad de Gestión Educativa Local - UGEL"). Then, MINEDU announces the hiring process at the national level and the requirements in terms of different examination stages for teachers to pass. In the first step of this evaluation process, MINEDU applies a Unique National Test ("Prueba Única Nacional – PUN") for all teachers registered in this contract process. The teachers with the best scores can apply for the available positions. Then these teachers are evaluated in a decentralized process, in which evaluation committees from schools examine them and the successful applicants obtain a permanent contract. The empty positions are occupied by contracted teachers, who apply directly to the UGELs. In October 2015, the first national

[22] https://www.minedu.gob.pe/reforma-magisterial/docentes-contratados.php
[23] https://www.edugestores.pe/wp-content/uploads/2016/10/Estadisticas-docentes-2016.pdf
[24] https://www.minedu.gob.pe/reforma-magisterial/docentes-nombrados.php

teacher recruitment process was developed.

In the private sector, the hiring processes are different and heterogeneous. Teachers are directly contracted by private institutions. On average their salary is around S/ 1330 soles (US$ 380) (Cuenca, 2017). The specifications of their contracts are not related to the Law of Magisterium Reform. They have the same standard labor arrangements as any other worker in a private company. According to the National School Census, 30% of basic education teachers in 2018 worked in private schools.

Despite the efforts to standardize the public hiring process, teachers' salaries are below those of other comparable professional groups. As a consequence, a substantial percentage of teachers have to work in secondary occupations to supplement their income. Mizala and Ñopo (2016) report that, between 1997 and 2007, Peru was one of the Latin American countries where teachers' salaries lagged most behind those of other professionals and technicians. This wage gap, measured after controlling for observable characteristics concerning their professional and technical peers, was second to Nicaragua's alone. Previously, Saavedra (2004) had already shown that the real wage of teachers had a long-term decreasing trend. In a more recent study, Díaz and Ñopo (2016) report a relative deterioration in the salary of teachers in Peru between 2004 and 2014. Indeed, teachers' relative salaries have passed from being in the 30th percentile of the distribution of salaries for professionals and technicians in the country to being placed in the 20th percentile in the same period. It is worth mentioning that this trend has been reversed slightly in recent years due to an increase in teachers' salaries. However, this improvement was not enough for teachers, who went on strike several times in 2017 to secure an increase in their salaries.

B National Teacher Survey: Descriptive statistics

Table B.1: Public sector teachers: Pooled sample, 2016-2018

	Percentage		Percentage
Survey year		**Type of contract**	
Total	100.0	Total	100.0
2016	47.0	Fixed-term	34.6
2018	53.0	Permanent	65.4
School area		**Gender**	
Total	100.0	Total	100.0
Rural	31.8	Male	44.2
Urban	68.2	Female	55.8
Teaching level		**Age**	
Total	100.0	Total	100.0
Primary	50.6	<=29	4.9
Secondary	49.4	30-39	23.0
		40-49	36.0
		50-59	29.8
		>=60	6.2

Source: National Teacher Survey 2016 and 2018.
Own elaboration.

Table B.2: Sample of teachers per cluster

Number of teachers per cluster	Nb of clusters	Percentage
Total	**3,720**	**100.00**
1	815	21.91
2	826	22.21
3	468	12.58
4	557	14.98
5	471	12.66
6	249	6.70
>=7	333	8.96

Source: National Teacher Survey 2016-2018.
Own elaboration.

Table B.3: School sample: Main characteristics

	Nb schools	Percentage	Maths z-score
Survey year			
Total	3,310	100.00	0.073
2016	2,106	63.63	0.123
2018	1,204	36.37	-0.014
Educational level			
Total	3,310	100.00	0.073
Primary	2,034	61.45	0.151
Secondary	1,276	38.55	-0.052
Area			
Total	3,310	100.00	0.073
Rural	1,279	38.64	-0.348
Urban	2,031	61.36	0.338
Natural region			
Total	3,310	100.00	0.073
Costa	1,141	34.47	0.437
Sierra	1,384	41.81	0.052
Selva	785	23.72	-0.419

Source: National Teacher Survey and Census Student Assessment, 2016 and 2018.
Own elaboration.

C Exploratory Factor Analysis

Table C.1: Two-factor solution for TSWB: Factor loadings and unique variances after Promax rotation

	SWB item code	Factor1	Factor2	Uniqueness
2	Health	0.136	0.446	0.711
4	Own children education	0.134	0.496	0.657
5	Retirement conditions	-0.198	0.826	0.473
6	Self-esteem	0.444	0.244	0.614
7	Society recognition	0.178	0.488	0.627
8	Family relationships	0.502	0.201	0.587
9	Recreational activities	0.114	0.556	0.603
11	Students' achievement and relat.	0.504	0.084	0.689
12	MINEDU recognition	0.011	0.629	0.597
13	Colleagues relationships	0.778	-0.114	0.487
14	Principal relationship	0.720	-0.120	0.570
15	Students' parents relationships	0.804	-0.062	0.409
16	School location	0.414	0.097	0.772
17	Salary	-0.091	0.682	0.601
18	Community relationships	0.735	0.005	0.455

Note: The item code corresponds to Table 1.
Source: National Teacher Survey 2016 and 2018. Own elaboration.

Table C.2: Three-factor solution for TSWB: Factor loadings and unique variances after Promax rotation

	SWB item code	Factor1	Factor2	Factor3	Uniqueness
2	Health	-0.053	0.490	0.180	0.664
4	Own children education	-0.083	0.555	0.198	0.589
5	Retirement conditions	-0.106	0.040	0.764	0.444
6	Self-esteem	0.095	0.791	-0.150	0.405
7	Society recognition	0.155	0.174	0.393	0.631
8	Family relationships	0.191	0.692	-0.135	0.445
9	Recreational activities	-0.082	0.530	0.265	0.552
11	Students' achievement and relat.	0.397	0.202	0.030	0.693
12	MINEDU recognition	0.147	-0.145	0.733	0.469
13	Colleagues relationships	0.684	0.096	-0.063	0.489
14	Principal relationship	0.675	0.010	-0.030	0.553
15	Students' parents relationships	0.812	-0.038	0.047	0.341
16	School location	0.389	0.050	0.118	0.764
17	Salary	0.029	-0.088	0.732	0.512
18	Community relationships	0.690	0.060	0.058	0.432

Note: The item code corresponds to Table 1.
Source: National Teacher Survey 2016 and 2018. Own elaboration.

Table C.3: Four-factor solution for TSWB: Factor loadings and unique variances after Promax rotation

	SWB item code	Factor1	Factor2	Factor3	Factor4	Uniqueness
2	Health	0.502	-0.102	0.190	0.025	0.660
4	Own children education	0.560	-0.066	0.198	-0.039	0.592
5	Retirement conditions	0.037	-0.086	0.767	-0.024	0.444
6	Self-esteem	0.811	0.022	-0.146	0.047	0.404
7	Society recognition	0.172	0.249	0.369	-0.086	0.616
8	Family relationships	0.710	0.127	-0.137	0.048	0.446
9	Recreational activities	0.535	-0.054	0.263	-0.050	0.555
11	Students' achievement and relat.	0.210	0.411	0.001	0.011	0.679
12	MINEDU recognition	-0.140	0.112	0.728	0.051	0.472
13	Colleagues relationships	0.131	0.146	-0.015	0.606	0.409
14	Principal relationship	-0.011	-0.037	0.044	0.919	0.178
15	Students' parents relationships	-0.048	0.798	0.002	0.105	0.299
16	School location	0.056	0.340	0.103	0.076	0.766
17	Salary	-0.090	-0.026	0.746	0.062	0.502
18	Community relationships	0.024	0.871	-0.016	-0.058	0.287

Note: The item code corresponds to Table 1.
Source: National Teacher Survey 2016 and 2018. Own elaboration.

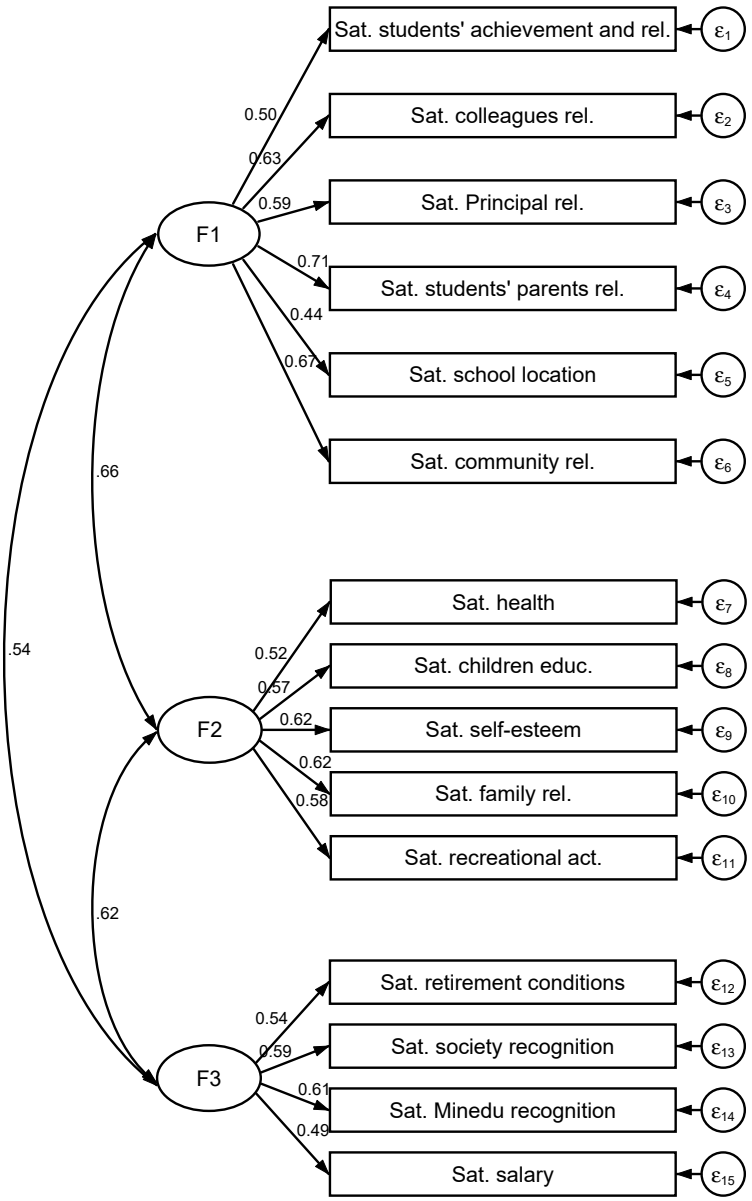
Table C.4: Five-factor solution for TSWB: Factor loadings and unique variances after Promax rotation

	SWB item code	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
2	Health	0.476	-0.087	0.180	0.027	0.105	0.663
4	Own children education	0.485	0.024	0.145	-0.035	0.242	0.566
5	Retirement conditions	0.048	-0.110	0.763	-0.028	0.040	0.453
6	Self-esteem	0.907	-0.096	-0.105	0.042	-0.091	0.343
7	Society recognition	0.234	0.144	0.428	-0.096	-0.137	0.583
8	Family relationships	0.670	0.143	-0.134	0.056	0.083	0.458
9	Recreational activities	0.449	0.049	0.205	-0.046	0.269	0.519
11	Students' achievement and relat.	0.283	0.302	0.060	0.004	-0.195	0.643
12	MINEDU recognition	-0.097	0.015	0.787	0.049	-0.106	0.438
13	Colleagues relationships	0.136	0.122	-0.005	0.617	-0.026	0.402
14	Principal relationship	-0.008	-0.029	0.041	0.904	0.002	0.197
15	Students' parents relationships	-0.062	0.797	-0.007	0.118	-0.035	0.304
16	School location	0.019	0.377	0.080	0.083	0.058	0.760
17	Salary	-0.154	0.038	0.708	0.068	0.178	0.482
18	Community relationships	-0.021	0.928	-0.047	-0.057	0.012	0.262

Note: The item code corresponds to Table 1.
Source: National Teacher Survey 2016 and 2018. Own elaboration.

D Confirmatory Factor Analysis

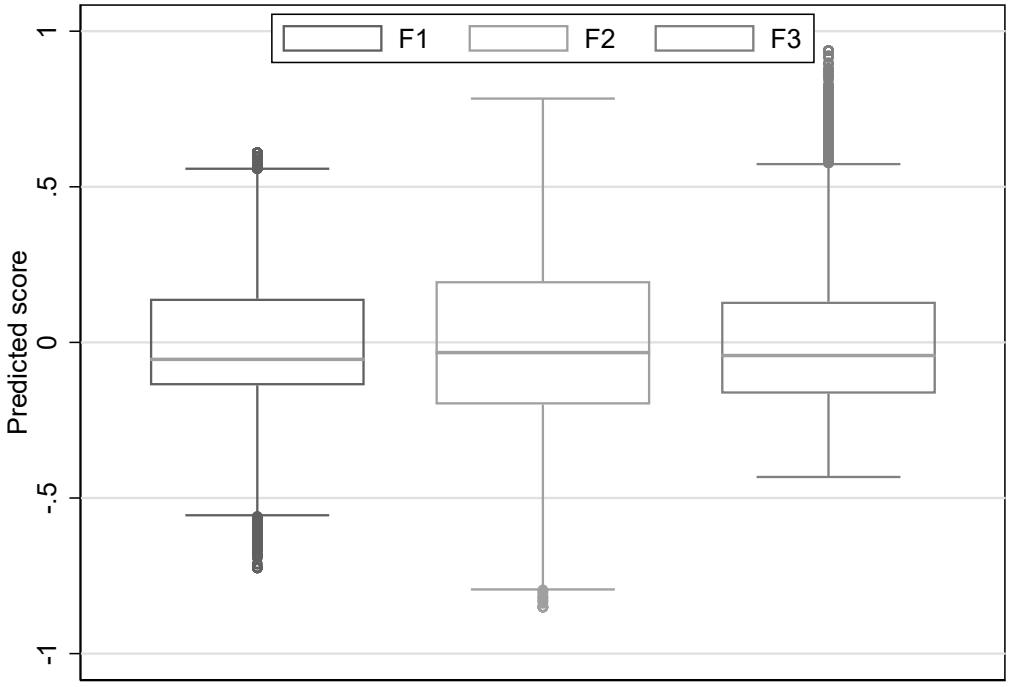
Figure D.1: Teacher subjective well-being: Confirmatory Factor Analysis path diagram



Note: Paths' values display standardized parameters.

Source: National Teacher Survey 2016 and 2018. Own elaboration.

Figure D.2: Teacher subjective well-being factors' distributions (teacher level): Predicted values from CFA



Source: National Teacher Survey, 2016-2018. Own elaboration.

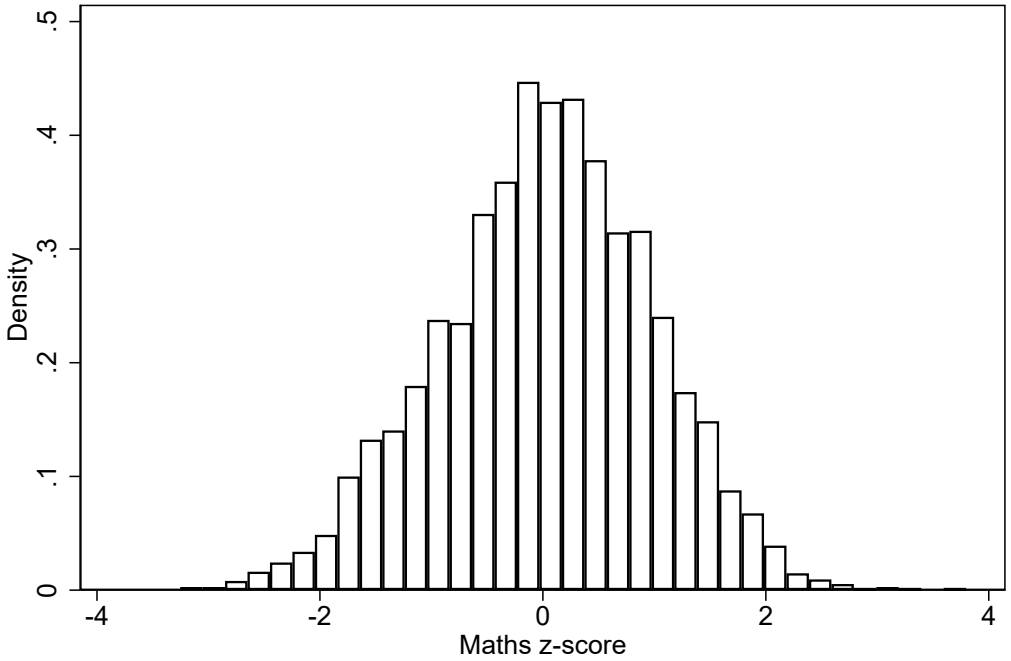
E Determinants of teacher subjective well-being factors, at the individual level

Table E.1: OLS estimates - Dep. variable: TSWB factors

	F1	F2	F3
Age	0.001*	0.001***	0.002***
	(0.000)	(0.000)	(0.000)
Female	0.007	-0.017*	-0.003
	(0.007)	(0.008)	(0.006)
Native mother tongue	0.056**	0.022	0.015
	(0.019)	(0.019)	(0.016)
Native	0.011	0.019*	0.011
(autoperception)	(0.008)	(0.009)	(0.007)
Native mother tongue	-0.042*	-0.018	0.002
X autoperception	(0.021)	(0.022)	(0.018)
Household head	0.003	-0.008	-0.001
	(0.007)	(0.007)	(0.006)
Has a secondary	0.023**	0.026**	0.011
occupation	(0.008)	(0.010)	(0.007)
Illness (number)	-0.011***	-0.019***	-0.014***
	(0.001)	(0.001)	(0.001)
Fixed-term contract	-0.004	0.013	0.013*
	(0.007)	(0.009)	(0.007)
Aspirational wage	-0.008***	-0.009***	-0.018***
gap	(0.001)	(0.002)	(0.002)
Satisfaction with	0.029***	0.082***	0.054***
hosehold income	(0.005)	(0.006)	(0.005)
Teacher by vocation	0.023***	0.035***	0.025***
	(0.006)	(0.006)	(0.005)
Would choose	0.022**	0.041***	0.030***
teaching profession again	(0.007)	(0.008)	(0.006)
Want to change	-0.023***	-0.007	-0.009
school district	(0.006)	(0.007)	(0.005)
Satisfied with	0.098***	0.081***	0.042***
current employment	(0.010)	(0.012)	(0.008)
Would like her	0.036***	0.048***	0.047***
children to be teachers	(0.006)	(0.007)	(0.006)
Secondary school	-0.027***	-0.006	-0.024**
	(0.008)	(0.009)	(0.007)
Urban public school	0.001	0.003	-0.004
	(0.008)	(0.009)	(0.007)
Poverty rate (school	0.000*	0.001*	0.001***
district)	(0.000)	(0.000)	(0.000)
Ratio students per	0.000	0.000	0.000
teacher	(0.001)	(0.001)	(0.001)
Female teacher ratio	-0.023	-0.024	-0.022
	(0.016)	(0.018)	(0.016)
Fixed-term teacher	-0.011	-0.017	0.019
ratio	(0.014)	(0.016)	(0.013)
Constant	-0.157***	-0.301***	-0.204***
	(0.036)	(0.043)	(0.033)
No. of obs.	12,752	12,752	12,752
R-squared	0.102	0.146	0.164
F	25.39	38.90	46.12

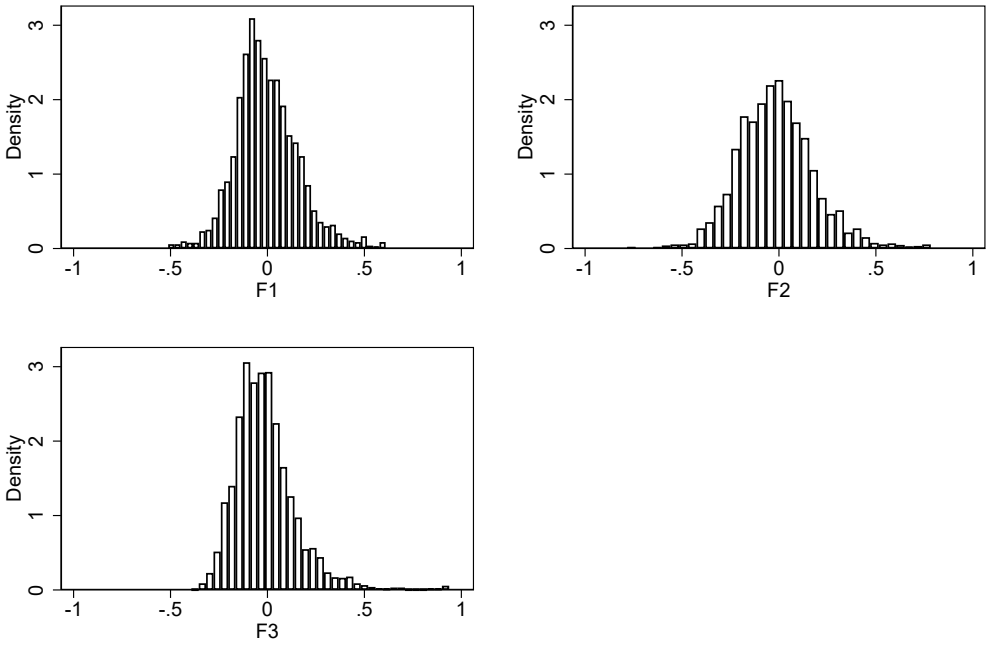
F Main variables distribution

Figure F.1: Basic education schools: Average pupils' maths z-scores



Source: National Teacher Survey and Census Student Assessment, 2016 and 2018.
Own elaboration.

Figure F.2: Basic education schools: Average teacher subjective well-being factors' predicted values



Source: National Teacher Survey and Census Student Assessment, 2016 and 2018.
Own elaboration.

G OLS estimates

Table G.1: OLS estimates - Dep. variable: School average score in maths

	(1)	(2)	(3)
F1	0.169*		
	(0.091)		
F1 squared	-0.916***		
	(0.344)		
F2		0.069	
		(0.076)	
F2 squared		-0.395*	
		(0.231)	
F3			0.068
			(0.106)
F3 squared			-0.538**
			(0.250)
Maths z-score in 2015	0.482***	0.484***	0.484***
	(0.021)	(0.021)	(0.021)
Urban public school	0.163***	0.166***	0.167***
	(0.036)	(0.036)	(0.036)
Poverty rate	-0.149	-0.146	-0.150
	(0.097)	(0.098)	(0.098)
Absenteeism in the previous year (days per month)	0.004	0.005	0.008
	(0.026)	(0.026)	(0.026)
Total nb teachers	0.001*	0.001*	0.001*
	(0.001)	(0.001)	(0.001)
Female teacher ratio	0.455***	0.451***	0.442***
	(0.084)	(0.084)	(0.084)
Fixed-term teacher ratio	-0.101	-0.103	-0.099
	(0.063)	(0.063)	(0.062)
Student-teacher ratio	-0.000	0.000	0.000
	(0.002)	(0.002)	(0.002)
Nb rooms	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)
N	3,215	3,215	3,215
r2	0.494	0.493	0.493
F	141.17	140.66	141.83

Standard errors in parentheses

Note: All regressions include survey year, geographic domain, and student assessment grade fixed-effects.

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table G.2: OLS estimates - Dep. variable: School average score in maths

	(1)	(2)	(3)	(4)
F1	0.213	0.285**		0.165
	(0.154)	(0.126)		(0.157)
F2	-0.044		0.165	0.042
	(0.132)		(0.122)	(0.156)
F3		-0.139	-0.077	-0.145
		(0.143)	(0.165)	(0.168)
F1 squared	-1.165	-1.181*		-0.858
	(0.866)	(0.625)		(0.869)
F2 squared	-0.143		-1.399**	-1.449
	(0.744)		(0.650)	(1.054)
F3 squared		-0.611	-2.204**	-2.223**
		(0.629)	(0.876)	(0.901)
F1xF2	0.400			0.845
	(1.459)			(1.572)
F1xF3		0.976		-1.827
		(1.174)		(1.589)
F2xF3			3.206**	3.976**
			(1.427)	(1.745)
F1xF2xF3				1.453
				(1.115)
Constant	-0.160*	-0.162*	-0.163*	-0.146
	(0.092)	(0.091)	(0.091)	(0.093)
N	3,215	3,215	3,215	3,215
r2	0.494	0.495	0.495	0.497
F	123.03	123.34	123.02	101.44

Standard errors in parentheses

Note: All regressions include the same covariates and fixed-effects as from Table G.1.

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

H IV first stage by TSWB factor

Table H.1: OLS estimates - Dep. variable: TSWB Factor 1

	(1) Z1	(2) Z2	(3) Z3
Commuting time to school (Z1)	-0.055**		
	(0.023)		
Z1-squared	0.005		
	(0.003)		
Electoral participation in 2016 (Z2_a)		-0.385	
		(0.525)	
Z2_a squared		0.251	
		(0.365)	
Electoral support to conservative party in 2016 (Z_2b)		0.002	
		(0.002)	
Z2_b squared		-0.000*	
		(0.000)	
School maths score trend 2012-2016 (Z3)			0.013
			(0.020)
Z3-squared			0.159***
			(0.052)
Math z-score in 2015	0.017***	0.017***	0.015***
	(0.004)	(0.004)	(0.005)
Urban public school	-0.026***	-0.017*	-0.016
	(0.009)	(0.009)	(0.011)
Poverty rate	0.025	0.008	0.003
	(0.025)	(0.029)	(0.029)
Absenteeism in the previous year (days per month)	-0.008	-0.009	-0.010
	(0.006)	(0.006)	(0.006)
Total nb teachers	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)
Female teacher ratio	-0.063***	-0.062***	-0.068***
	(0.018)	(0.019)	(0.021)
Fixed-term teacher ratio	0.017	0.008	-0.013
	(0.017)	(0.016)	(0.019)
Student-teacher ratio	0.002**	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
Nb rooms	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Constant	0.172***	0.125	0.018
	(0.054)	(0.191)	(0.026)
N	3,215	3,208	2,612
r2	0.094	0.088	0.099
F	11.48	9.60	9.37

Standard errors in parentheses

Note: All regressions include survey year and student assessment grade fixed-effects.

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table H.2: OLS estimates - Dep. variable: TSWB Factor 2

	(1) Z1	(2) Z2	(3) Z3
Commuting time to school (Z1)	-0.045		
	(0.028)		
Z1-squared	0.004		
	(0.004)		
Electoral participation in 2016 (Z2_a)		-0.749	
		(0.736)	
Z2_a squared		0.494	
		(0.509)	
Electoral support to conservative party in 2016 (Z_2b)		0.001	
		(0.002)	
Z2_b squared		-0.000	
		(0.000)	
School maths score trend 2012-2016 (Z3)			0.008
			(0.025)
Z3-squared			0.203***
			(0.060)
Math z-score in 2015	0.010*	0.010*	0.008
	(0.005)	(0.005)	(0.006)
Urban public school	-0.015	-0.006	-0.001
	(0.011)	(0.011)	(0.013)
Poverty rate	0.010	-0.009	-0.023
	(0.031)	(0.036)	(0.037)
Absenteeism in the previous year (days per month)	-0.000	-0.000	-0.002
	(0.008)	(0.009)	(0.009)
Total nb teachers	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Female teacher ratio	-0.091***	-0.090***	-0.091***
	(0.022)	(0.022)	(0.024)
Fixed-term teacher ratio	0.035*	0.024	0.001
	(0.020)	(0.020)	(0.024)
Student-teacher ratio	0.001	0.001	0.002**
	(0.001)	(0.001)	(0.001)
Nb rooms	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Constant	0.157**	0.282	0.016
	(0.065)	(0.266)	(0.033)
N	3,215	3,208	2,612
r2	0.094	0.091	0.099
F	11.95	10.38	10.07

Standard errors in parentheses

Note: All regressions include survey year and student assessment grade fixed-effects.

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table H.3: OLS estimates - Dep. variable: TSWB Factor 3

	(1) Z1	(2) Z2	(3) Z3
Commuting time to school (Z1)	-0.074***		
	(0.026)		
Z1-squared	0.008**		
	(0.003)		
Electoral participation in 2016 (Z2_a)		-1.141	
		(0.768)	
Z2_a squared		0.736	
		(0.523)	
Electoral support to conservative party in 2016 (Z_2b)		0.001	
		(0.002)	
Z2_b squared		-0.000	
		(0.000)	
School maths score trend 2012-2016 (Z3)			0.015
			(0.022)
Z3-squared			0.126**
			(0.056)
Math z-score in 2015	0.005	0.006	0.002
	(0.004)	(0.004)	(0.005)
Urban public school	-0.025***	-0.018**	-0.017
	(0.009)	(0.009)	(0.010)
Poverty rate	0.052**	0.031	0.035
	(0.026)	(0.029)	(0.031)
Absenteeism in the previous year (days per month)	0.003	0.003	0.001
	(0.010)	(0.011)	(0.011)
Total nb teachers	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Female teacher ratio	-0.056***	-0.056***	-0.053**
	(0.019)	(0.019)	(0.021)
Fixed-term teacher ratio	0.049***	0.042**	0.028
	(0.018)	(0.017)	(0.021)
Student-teacher ratio	0.001*	0.001**	0.002**
	(0.001)	(0.001)	(0.001)
Nb rooms	-0.000**	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)
Constant	0.152**	0.399	-0.020
	(0.061)	(0.279)	(0.026)
N	3,215	3,208	2,612
r2	0.087	0.086	0.087
F	11.26	9.87	9.08

Standard errors in parentheses

Note: All regressions include survey year and student assessment grade fixed-effects.

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I Quantile regression estimates

Table I.1: TSWB Factor 1: Quantile regression estimates - Dep. variable: School average score in math

	(1) Q10	(2) Q30	(3) Q50	(4) Q70	(5) Q90
F1	0.139	0.213***	0.127	0.142	0.273***
	(0.099)	(0.073)	(0.085)	(0.091)	(0.079)
F1 × F1	-0.553	-1.033***	-1.089***	-0.810**	-1.169***
	(0.362)	(0.241)	(0.287)	(0.327)	(0.273)
N	3,215	3,215	3,215	3,215	3,215
r2_p	0.377	0.355	0.330	0.302	0.253

Standard errors in parentheses

Note: All regressions include the same controls and fixed-effects as from Table G.1.

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table I.2: TSWB Factor 2: Quantile regression estimates - Dep. variable: School average score in math

	(1) Q10	(2) Q30	(3) Q50	(4) Q70	(5) Q90
F2	-0.070	0.133**	0.094	0.158*	0.117
	(0.075)	(0.057)	(0.073)	(0.084)	(0.081)
F2 × F2	-0.364	-0.548***	-0.846***	-0.437	0.151
	(0.248)	(0.137)	(0.243)	(0.310)	(0.264)
N	3,215	3,215	3,215	3,215	3,215
r2_p	0.376	0.354	0.330	0.301	0.251

Standard errors in parentheses

Note: All regressions include the same controls and fixed-effects as from Table G.1.

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table I.3: TSWB Factor 3: Quantile regression estimates - Dep. variable: School average score in math

	(1) Q10	(2) Q30	(3) Q50	(4) Q70	(5) Q90
F3	-0.120	0.080	0.048	0.048	0.086
	(0.123)	(0.096)	(0.096)	(0.108)	(0.111)
F3 × F3	-0.498	-0.458	-0.673***	-0.412	-0.367*
	(0.505)	(0.328)	(0.259)	(0.390)	(0.198)
N	3,215	3,215	3,215	3,215	3,215
r2_p	0.377	0.353	0.329	0.301	0.251

Standard errors in parentheses

Note: All regressions include the same controls and fixed-effects as from Table G.1.

Source: National Teacher Survey and Student Census Assessment, 2016-2018.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

J Pseudo-panel fixed-effects models

Table J.1: Panel data fixed-effects model - Dep. variable: School average score in maths by grade

	(1) 4th primary	(2) 2nd secondary
F1	1.076**	0.051
	(0.417)	(0.292)
F1 squared	-1.526	0.681
	(1.469)	(1.601)
Total nb teachers	-0.025	0.004
	(0.026)	(0.009)
Female teacher ratio	-0.099	-0.164
	(0.764)	(0.397)
Fixed-term teacher ratio	1.132**	-0.643*
	(0.480)	(0.345)
Student-teacher ratio	0.037	-0.000
	(0.030)	(0.008)
Nb rooms	0.004*	-0.000
	(0.002)	(0.002)
Poverty rate	-0.649	-0.080
	(0.727)	(0.615)
Constant	-0.001	0.497
	(1.023)	(0.472)
N_clust	79	110
r2_w	0.233	0.041
r2_b	0.036	0.032
r2_o	0.014	0.033
sigma_u	0.978	0.816
sigma_e	0.381	0.352
rho	0.868	0.843

Standard errors in parentheses

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table J.2: Panel data fixed-effects model - Dep. variable: School average score in maths by grade

	(1) 4th primary	(2) 2nd secondary
F2	0.719***	0.153
	(0.244)	(0.244)
F2 squared	0.385	-0.428
	(1.023)	(0.918)
Total nb teachers	-0.028	0.004
	(0.025)	(0.009)
Female teacher ratio	-0.412	-0.159
	(0.746)	(0.381)
Fixed-term teacher ratio	1.159**	-0.681*
	(0.554)	(0.346)
Student-teacher ratio	0.033	-0.001
	(0.026)	(0.007)
Nb rooms	0.004**	-0.000
	(0.002)	(0.002)
Poverty rate	-0.581	-0.011
	(0.704)	(0.659)
Constant	0.295	0.518
	(0.890)	(0.446)
N_clust	79	110
r2_w	0.215	0.045
r2_b	0.071	0.032
r2_o	0.038	0.033
sigma_u	1.015	0.817
sigma_e	0.385	0.351
rho	0.874	0.844

Standard errors in parentheses

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table J.3: Panel data fixed-effects model - Dep. variable: School average score in maths by grade

	(1) 4th primary	(2) 2nd secondary
F3	0.936***	0.222
	(0.323)	(0.298)
F3 squared	-0.012	-0.434
	(1.592)	(0.786)
Total nb teachers	-0.038	0.003
	(0.027)	(0.009)
Female teacher ratio	-0.332	-0.140
	(0.708)	(0.392)
Fixed-term teacher ratio	1.182**	-0.680*
	(0.590)	(0.371)
Student-teacher ratio	0.026	-0.002
	(0.026)	(0.007)
Nb rooms	0.004**	-0.001
	(0.002)	(0.002)
Poverty rate	-0.502	0.021
	(0.710)	(0.675)
Constant	0.599	0.528
	(0.925)	(0.445)
N_clust	79	110
r2_w	0.231	0.045
r2_b	0.078	0.027
r2_o	0.045	0.028
sigma_u	1.083	0.819
sigma_e	0.381	0.351
rho	0.890	0.845

Standard errors in parentheses

Source: National Teacher Survey and Student Census Assessment, 2016-2018. Own elaboration.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$