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Guidelines for data fusion with international large scale assessments: Insights from the TALIS-PISA link database

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ABSTRACT

This paper focuses on the potential uses and misuses that can be made with the so-called TALIS-PISA link created by the OECD. This is a recently developed instrument that allows for connecting data about teachers collected in TALIS with students data available in PISA. However, the statistical and technical aspects regarding this link between both surveys are far from straightforward. In this paper we explore the main problematic issues of the data fusion process and provide some guidelines for researchers interested in performing empirical analyses using the resulting dataset. Likewise, we illustrate some potential utilities of this dataset through the estimation of different models with the aim of exploring the relationships between teaching practices and student achievement in Spain. Our results indicate that students whose teachers concentrate on a few instructional practices obtain better results than those who have teachers using many different activities within the classroom.

1. Introduction

It is widely accepted within the educational research community that teachers play a pivotal role in the education sector (Creemers, 1994; Hanushek, 2011). For several decades, researchers have examined the associations between student achievement and a wide variety of teacher variables, including background characteristics, their beliefs and attitudes and the instructional practices applied in the classroom (Palardy & Rumberger, 2008; Boonen, Van Damme, & Onghena, 2014). However, the relationships have often been difficult to quantify and understand empirically because there are many factors that might have influence on this relationship (Rockoff, 2004). As a result, there is still a lack of consensus about which aspects of teachers matter most (Nye, Konstantopoulos, & Hedges, 2004, Rivkin, Hanushek, & Kain, 2005; Hattie, 2009).

Until relatively recently, the majority of the available empirical evidence on this topic was referred to the specific context of the United States, since data about teachers were mainly available in this country.[1] However, the remarkable development of international large-scale assessments (ILSA) over the past two decades offer researchers new opportunities to explore relationships between teacherś characteristics and their instructional practices and learning outcomes (Rowan, Correnti, & Miller, 2002; Chapman et al., 2012) in other countries or even using a cross-country approach. Perhaps the best known ILSAs are the Trends in Mathematics and Science Study (TIMSS), conducted by the International Association for the Evaluation of Educational Achievement (IEA), and the Programme for International Student Assessment (PISA) and Teaching and Learning International Survey (TALIS), conducted by the Organisation for Economic Cooperation and Development (OECD).

Most part of recent research on teacher effects with international datasets uses data from TIMSS (Mullis, Martin, Foy, & Arora, 2012),[2] since this is the only ILSA that provides data on students, teachers and schools. For instance, Schwerdt and Wuppermann (2011) and Van Klaveren (2011) use TIMSS 2003 data for US and Netherlands, respectively, to examine the influence of teaching practices on student achievement. House (2009) and Bietenbeck (2014) analyse the effect of different types of instruction using data from TIMSS 2007 for fourth-grade students in Japan and US eight-grade students, respectively. Zuzovsky (2013) and O'Dwyer, Wang, and Shields, 2015 also explore the relationship between instructional practices and eighth grade students performance using data TIMSS 2007 in a cross-country approach. Finally, the recent book edited by Nilsen and Gustafsson (2016) is a valuable contribution to this growing body of research, since it contains several empirical studies analysing TIMSS data across different countries and grades (four and eight) and taking account of multiple

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[1] Other developed countries such as United Kingdom, Netherlands or Australia have also made great efforts to collect data about teachers.

[2] See Drent, Meelissen, and van der Kleij, 2013 or Cordero et al. (2017) for detailed reviews of this literature.

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background variables.

In contrast, empirical studies about this topic using the OECD PISA and TALIS surveys are extremely scarce. This can be explained by the fact that data about teachers has been traditionally missing in the PISA dataset[3] and data about students is missing in the TALIS dataset. As pointed out by Kaplan and McCarty (2013), an ideal approach to linking the PISA survey to the TALIS survey would be to sample schools and administer questionnaires from both PISA and TALIS in the same school. This possibility may not be feasible for many countries, but the last wave of the TALIS survey released in 2013 included the possibility of linking the available data to the PISA 2012 dataset through the so-called TALIS-PISA link (OECD, 2016). Although only eight out of all the countries participating in both surveys chose this option (Australia, Finland, Latvia, Mexico, Portugal, Romania, Singapore and Spain), at least now it is possible to analyse teacher effectiveness using data from those OECD surveys.

Since the statistical and technical issues regarding this link between both surveys are far from straightforward, the aim of this paper is to explore the main characteristics of this data fusion process and provide some guidelines for researchers interested in performing empirical analyses using the resulting dataset. Additionally, we illustrate the alternative fusion process that can be adopted with an empirical analysis of the association between teaching practices and student characteristics and outcomes in the specific context of Spain, since this country presents the largest sample of observations among participating countries in this novel process.

The main contribution of this paper relies on the fact that many of the recommendations and guidelines driven from this paper can be helpful for other matching process with different databases. In this sense, it is worth mentioning that in the last decades the availability of large and reliable surveys (at national and international level) has considerably increased, but in many cases all the information required for implementing empirical analyses is not included in one dataset, thus researchers frequently need to merge data from different sources. For this reason, the conclusions and precautions derived from our analysis can be taken into account and reproduced in other contexts.

The remainder of the paper is organized as follows. In Section 2, we describe the main characteristics of the TALIS and PISA databases, as well as the fusion process. In Section 3, we explore the main strengths and weaknesses of the resulting merged dataset and provide some recommendations for researchers interested in exploiting this data source. Section 4 presents the results of the empirical analysis performed to show some of the potential utilities of the TALIS-PISA link dataset. Finally, section 5 outlines the main conclusions.

2. Datasets

In this section we explain some basic aspects regarding the structure of the two international surveys analysed in this study as well as some basic methodological aspects related to their fusion via the so-called TALIS-PISA link.

TALIS is an international large-scale survey that focuses on the working conditions of teachers and the learning environment in schools (OECD, 2014a, b,c). TALIS links institutional characteristics to aspects of school and classroom climate from the perspective of teachers and school administrators. The study provides insights into the beliefs and attitudes about teaching that teachers bring to the classroom and the pedagogical practices that they adopt. TALIS also informs about the extent to which certain factors may relate to teachers' feelings of job satisfaction and self-efficacy. The first round of TALIS was conducted in 2008 and surveyed lower secondary education teachers and school leaders in 24 countries. The second round was carried out in 2013, including 34 countries. For reliable estimation and modelling, 200 schools and 20 teachers per school were surveyed in each participating country. Therefore, the nominal international sample was around 4000 teachers. As a result, the dataset includes information from more than 10,000 schools and more than 170,000 teachers. The variables included in the database can be classified into different categories: teachers' opinions and feedback, teachers' background and professional development, school management and mobility indicators.

PISA is an international survey that assesses the extent to which 15-year-old students around the world have acquired competences and skills in three key subjects (mathematics, reading and sciences). The study was first developed in 2000 and it has been carried out periodically every three years with a regular increase in the number of participating countries (65 in 2012). The dataset includes a wide variety of background information on the students collected using individual questionnaires (see OECD, 2014d for details). Most part of this information refers to students' family background (information about their parents and siblings, language spoken at home, possessions at home, etc.) and personal information (truancy, motivation and interests, subjective norms, self-efficacy, perceived control and attributions to failure, behaviour towards the subjects, out-of-school lessons, familiarity and experience with maths). Moreover, it also includes their views on teachers' instructional practices, school climate and learning environment, all of which are important aspects of teachers' working environment. There are also some interesting indices constructed by the OECD and provided in the database along with these original variables. In addition, school principals also complete a questionnaire providing information on school resources, the total number of teachers in the school or the school's responsibility for taking decisions.

During the enactment of the first round of TALIS, several countries expressed a desire to have the survey linked to PISA outcome measures, but this option was not fully implemented in the end.[4] During the second round, countries that had taken part in PISA 2012 also had the option of implementing TALIS at the same schools. This option, commonly known as the TALIS-PISA link, made it possible to merge information gathered by teachers and principals in TALIS and by students in PISA into a single dataset. Only eight out of all the countries participating in both surveys chose this option, although this limitation is partly offset by the fact that the sample includes countries with diverse educational systems and cultural contexts. This offers an interesting variability with respect to student achievement, family background, school characteristics and type of instructional practices.

The sample of schools invited to participate in the TALIS-PISA link had to be selected from the existing sample of schools participating in PISA 2012. In order to respect most of the structure of the original sample of schools, a systematic equiprobable random sample of schools was drawn from the PISA 2012 sample, within the original explicit strata and original frame order. Subject to PISA requirements, the nominal sample size for the TALIS-PISA link was set at 150 schools, although the final number of participant schools was lower in some countries. The average number of teachers interviewed was around 3000 for each country, although the Spanish sample doubles this number (see Table 1).

The target population included a representative sample of 20 teachers of 15-year-olds in the schools that took part in PISA and the principals of the respective schools. In addition, all mathematics teachers available at the schools included in the TALIS-PISA link sample were surveyed. They received an additional questionnaire, the mathematics teacher module, whose main aim was to gather more detailed information on teaching practices at classroom level. The teacher

[3] In 2012 PISA introduced a number of questions in the student questionnaire related to teaching strategies and the instructional context in the mathematics classroom that made it possible to conduct some empirical studies about the effectiveness of teacher strategies (e.g. Caro, Lenkeit, & Kyriakides, 2016). Subsequently, in PISA 2015, a teacher questionnaire was offered to PISA-participating countries for the first time.

[4] An experimental link to PISA 2006 was developed for interested countries, but no country took up this option.