Exploring the effect of financial literacy courses on student achievement: a cross-country approach using PISA 2012 data

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Abstract

The aim of this research is to explore whether the deployment of specialized courses on basic financial concepts at schools has a significant impact on how able students are to apply the knowledge and skills that they learn to real-life situations involving financial issues and decision making. To do this, we exploit the rich set of comparative data about the countries participating in the PISA 2012 financial literacy assessment. This includes 18 of the 70 countries participating in this wave of PISA. Our empirical analysis is based on a difference-in-differences approach comparing the results of the same students across two subjects (financial literacy and reading). We assume that the distribution of students across schools does not depend on the provision of financial education. Thus we can estimate the effect of the treatment as the difference between the performance of students at schools that offer or do not offer financial education courses. Our results suggest that such courses have a significant and positive effect on student achievement regardless of the strategy applied to teach financial concepts.

Keywords: Education policy, Cross-country study, Financial literacy, Difference-in-differences

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1. Introduction

Interest in financial literacy has increased massively worldwide based on the belief that its improvement will empower people to make better financial decisions (Hilgert et al., 2003; Borden et al., 2008). As a result, financial education programs figure prominently in the national public policy agenda of most countries (Lusardi and Mitchell, 2011, Appleyard and Rowlingson, 2013). Likewise, some international institutions such as the World Bank and the Organization for Economic Cooperation and Development (OECD) with its International Network on Financial Education (INFE) have made great efforts to promote financial literacy, coordinate national programs and provide guidance on the direction that such strategies should take in the future (OECD, 2012).

Even though most financial decisions are made by adults, all the above international bodies appear to be in agreement that it is crucial to begin cultivating financial literacy at school in the hope that students will develop the skills needed to successfully manage their finances in adulthood when they will be exposed to increasingly complex financial products and services. Moreover, there is evidence to show that young people's levels of financial literacy are consistently lower than for other demographics (Mandell, 2008; Shim et al., 2010). Therefore, the improvement of students' financial knowledge is essential so that they can participate in modern society (Lusardi et al., 2010) as well as being beneficial for the economy and society as a whole (Gnan et al., 2007; Lusardi and Mitchell, 2011).

As a result, many countries are developing plans to introduce contents related to financial education (FE) in their school curriculum, especially for low-income or lesser educated populations (Kozup and Hogarth, 2008). This should give the entire school-age population equal access to financial education. To do so, they are adopting different strategies. These strategies range from a well-developed framework to basic pilot programs to test the introduction of financial competences in the curriculum. However, the most common option is to merely provide a form of financial education by means of a cross-curricular approach, i.e., linking financial concepts with some other learning areas. Moreover, schools may adopt a flexible approach to the integration of financial education into the curriculum, and teachers may also decide whether or not to include aspects of financial literacy within their subjects. Therefore, there are a lot of

differences across territories and also among schools within the same territory (Grifoni and Messy, 2012; Atkinson and Messy, 2013).

In this paper, we attempt to exploit this heterogeneity in the international context in order to test the effect of financial education courses on students' knowledge of financial matters, since the existence of larger variations in school and population characteristics generally improves the prospects of detecting the impact of specific factors on student outcomes (Hanushek and Woessman, 2014, p. 147). For this purpose, we use data from the OECD's Programme for International Student Assessment (PISA), which included a module on financial literacy for the first time in 2012. In particular, students from 18 countries participated in this optional PISA assessment. The assessment provides comparable information with regard to the financial competences of 15-year-olds worldwide by testing their knowledge as applicable in everyday life situations rather than the reproduction of knowledge (OECD, 2014). The availability of such comparable data across countries is essential for understanding how well prepared young people are to deal with new and changing financial environments. Moreover, the dataset includes extensive information about individual characteristics, socio-economic background and school contexts. In this manner, the analysis can account for these factors.

One of the main concerns about using observational data from PISA is that omitted variables and selection bias are hard to account for when assessing the relationship between financial education programs and financial outcomes (Fox et al., 2005). For instance, the lack of information about students' cognitive abilities, which could possibly be correlated with other potential explanatory variables as well as having an influence on financial learning, could bias the estimation of the causal effect of financial education. To avoid this problem, our estimation strategy involves using a difference-in-differences (DiD) approach comparing the results achieved by the same students for two different subjects (differences between financial literacy and reading), as suggested by Jürges et al. (2005). The main advantage of this approach is that we use each student as his or her control group in order to control for most of the heterogeneity at the individual level represented by innate abilities. The key assumption required to identify the causal effect is that the difference in both outcome variables should be identical at schools not offering financial education, and hence the difference in excess of the

financial literacy test at schools offering financial education courses should reflect its impact.

This research falls within the scope of recent literature focusing on the assessment of the effectiveness of financial education programs (McCormick, 2009). Most existing papers regarding this topic refer to the specific context of the United States where high school financial education mandates have been enacted in many states over the past fifty years (Bernheim et al., 2001; Tennyson and Nguyen, 2001). Nevertheless, there are also some interesting initiatives in other developed and developing countries (e.g., Romagnoli and Trifilidis, 2013; Bechetti et al., 2013; Berry et al., 2015; Lührmann et al., 2015). All the above studies focus on specific programs with different characteristics implemented in highly heterogeneous contexts. Therefore, the evidence about their effectiveness is mixed (Walstad, 2013).

The scant previous evidence using a cross-country approach opens up opportunities as well as challenges, since very few studies have used international data to analyze differences in financial literacy across countries. Jappelli (2010) uses international panel data on 55 countries in order to explore the macroeconomic and institutional variables that are more likely to explain international differences in literacy across countries. Nicolini et al (2013) use a similar approach to collect data about only four countries and construct a financial literacy index based on the number of correct answers to similar questions in different national surveys.

In this article we attempt to take advantage of a common measure of financial literacy for students from different countries, as well as data about diverse initiatives retrieved by means of the same data collection process. Thus we can examine whether receiving some form of training about financial concepts is an effective practice for improving young students' financial knowledge. Furthermore, given that the PISA dataset also provides additional information about how financial education is implemented at each school, we also explore the effectiveness of different types of teaching strategies in an attempt to provide evidence about one of the most actively debated issues in both the scientific community and among educators.

The rest of the paper is structured as follows. Section 2 provides a brief literature review about the importance of financial education and its effects on student outcomes. Section 3 summarizes the situation of financial education in countries participating in the financial literacy test in PISA 2012, while Section 4 provides a description of the dataset and the variables considered in our analysis. Section 5 explains the estimation strategy, and Section 6 reports the main results. Finally, Section 7 outlines our conclusions.

2. Literature review

The literature studying the effects of financial education on both financial literacy and financial behaviors has grown over the last two decades (Xu and Zia, 2012; Lusardi and Mitchell, 2014, Miller et al., 2015). Before reviewing this literature, it is important to make a distinction between some interconnected concepts in order to gain a better understanding of the effects attributable to financial education programs (Fox et al., 2005). Financial education refers to the process of providing individuals with information or instruction to improve their understanding of financial products, develop their skills with regard to their awareness of risk and opportunities, making informed choices and taking effective actions for their financial wellbeing (OECD, 2005). Financial literacy can be interpreted as knowledge of the financial system, the ability to understand key financial concepts related to the management of money, loans and investment in different assets or both (Hung et al., 2009; Huston, 2010; Remund, 2010). Finally, financial outcomes refer to the skills and behaviors regarding how people deal with financial matters such as saving or participating in the stock market (Hastings et al., 2013).

Prior research has mainly explored the relationship between financial literacy and several financial behaviors and outcomes. The most relevant findings are that financial literacy is correlated to more prudent financial decisions such as savings and retirement planning (Bernheim et al., 2001; Lusardi and Mitchell, 2007, 2008; Cole et al., 2011), wealth accumulation (Behrman et al. 2012; Gustman et al., 2012); stock market participation (Abreu and Mendes 2010; Christelis et al., 2010; van Rooij, Lusardi, and Alessie 2011), bank account management (Grimes et al., 2010) or personal loans and mortgages at lower interest rates and with fewer bank commissions (Disney and

Gatherwood, 2013; Lusardi and Tufano, 2015). Likewise, there is available evidence indicating that individuals with low levels of financial literacy are less likely to participate in the stock market (Abreu and Mendes 2010; van-Rooij et al., 2011, 2012) or manage wealth effectively (Stango and Zinman 2009).

Assessing the effectiveness of financial education programs is more complex, since the results should not only be observed on better financial knowledge, but also on how participants apply their economic learning to their observed choices and behaviors after leaving the classroom (Allgood et al. 2004). In this respect, researchers agree that there should be stronger theoretical linkages between financial education and behaviors in order to develop a framework that can inform the choice of outcome measures (Lyons, 2006). In addition, it is important to separate adult education programs from school-based programs (McCormick, 2009; Wolfe-Hayes, 2010). In this research we focus on analyzing the relationship between financial education programs implemented in schools and the financial knowledge acquired by students.

While several authors are rather skeptical about the effective contributions of financial education (see Willis, 2008; Mandell and Klein, 2009; Cole et al. 2015), many others have found a positive correlation between its implementation and educational outcomes (Danes et al., 1999; Varcoe et al. 2005; Swinton et al., 2007; Harter and Harter 2009; Walstad et al., 2010; Batty et al., 2015). In any case, this evidence cannot be taken as confirmation that financial education programs should be an effective mechanism to improve financial outcomes, since there is no valid control group in most cases (Gale and Levine, 2010; Hastings et al. 2013). To establish program-induced causality, the outcome variable of the individuals that participated in the program (treated) has to be measured and compared against the value that the outcome variable would have taken if the individuals had not participated in the program (untreated or control) (Collins and O'Rourke, 2010). The problem with such studies is that the difference between participant and nonparticipant outcomes could be generated by preexisting differences in their characteristics and not by the program, whereby the evaluation suffers from a selection bias problem.

Experiments with random assignment, where there is homogeneity in the characteristics of schools implementing and not implementing financial education programs, are a

potential solution to this problem (Duflo et al. 2007). Nevertheless, when conducting an experiment is not possible and researchers only have access to observational data, one of the main challenges that researchers face is to account for the potential problem of endogeneity in data as a result of multiple potential sources, such as the presence of multiple confounding factors, simultaneity between the independent and dependent variable (reverse causality) or self-selection into financial education programs (Lusardi and Mitchell, 2014). In such cases, it is necessary to use an appropriate econometric approach to obtain valid results (Fox, 2005; Lyons et al., 2006; Willis, 2011).

To address this issue, several authors have used an instrumental variables estimation approach. This approach induces changes in the explanatory variable but has no independent effect on the dependent variable, allowing researchers to disclose a causal effect (e.g., Lusardi and Mitchell, 2009; Van Rooij et al., 2011, 2012; Klapper et al., 2012). An alternative option is a difference-in-differences approach, although it typically requires having data about two different periods (before and after implementing the program). This method was employed by Bernheim et al. (2001) to analyze the impact of state high school financial education mandates in the U.S. or Beccheti (2013) to evaluate the effect of financial education courses in Italian high schools.

The results of an extensive meta-analysis conducted by Fernandes et al. (2014) offer a useful breakdown of the types of studies that have been undertaken in the area. They use this classification to explain the apparently conflicting evidence that the studies provide. In particular, they make a clear distinction between studies focused on correlation (e.g., using OLS) and others using causal designs (experimental design or natural experiments) to conclude that financial education interventions have hardly any aggregate effect on improving financial literacy[1]. However, they found much larger effects in non-experimental studies applying a less rigorous econometric method. The findings of the literature review carried out by Miller et al. (2015) are similar, since most of the analyzed papers have positive outcomes for financial education, but many suffer from selection bias or other econometric concerns. Their explanation for these results is that the inflated effect detected in the analyzed studies might mask a problem

[1] They find that interventions to improve financial literacy explain only 0.1% of the variance in the studied financial behaviors, with weaker effects in low-income samples.

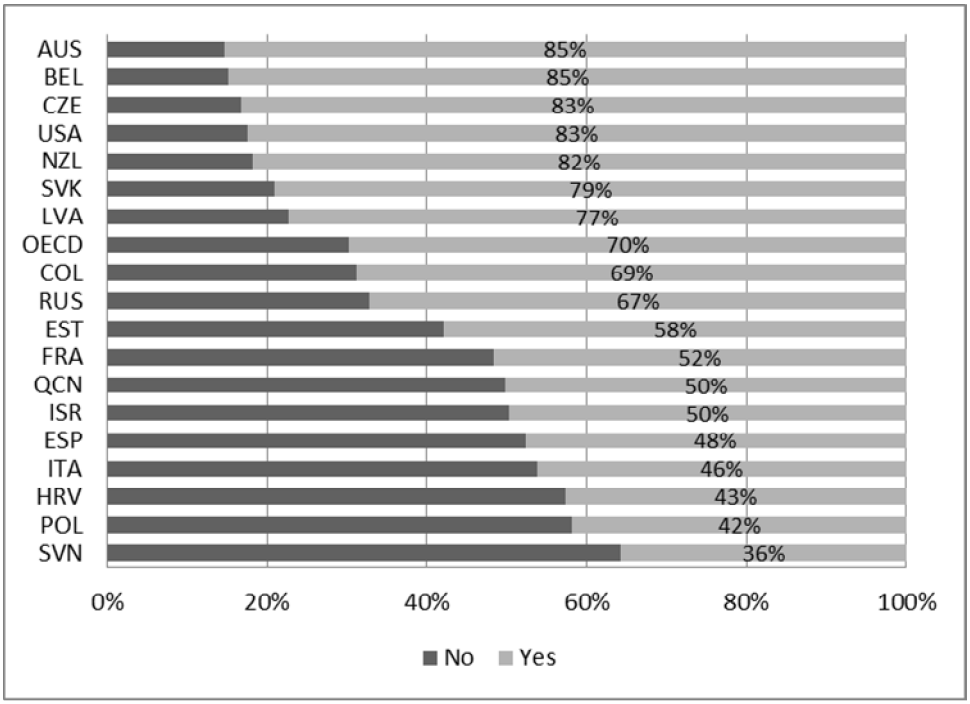
of omitted variables bias, since there are some underlying factors that have not been taken into account (e.g., innate abilities or interest in financial matters) and might contribute to both higher levels of financial literacy and better financial outcomes. Some previous papers have tried to deal with this issue. However, the available data did not allow a convincing identification strategy, and thus there are still some unresolved questions.

3. Financial education in countries participating in the PISA 2012 financial literacy test

As pointed out previously, the awareness of the importance of financial education has led many countries to develop an increasing number of national strategies for financial education. Such strategies represent a systematic approach to reinforce the financial literacy of their citizens (OECD, 2015). Those strategies started mostly in developed economies such as the United States, Japan, the United Kingdom, Australia, New Zealand, the Netherlands or Singapore. However, since the beginning of the economic crisis, such initiatives have spread to other countries with varying economic, financial and socio-demographic contexts (Grifoni and Messy, 2012).

One of the main challenges of such strategies is to include financial competences in primary and secondary school education programs to improve financial awareness from early ages. For example, several US states have adopted mandates to include financial education in the curriculum of high school students, while Australia has had a financial education mandate since 2011. However, only a few countries have so far established a well-developed framework for introducing financial competences into their education systems. Given that the main focus of this research is to analyze the effect of the availability of financial education courses on students' knowledge of financial issues, our starting point is to examine the proportion of students attending financial education courses in each country. Figure 1 shows this information based on the responses provided by the principals of schools participating in the PISA survey. Although the average percentage of students attending financial education courses is relatively high (70%), we observe that there is a very considerable variation across countries, ranging from percentages above 80% in Australia, Belgium, the United States or New Zealand to less than a half in Slovenia, Poland, Croatia, Italy or Spain.

Figure 1. Availability of FE in schools by countries



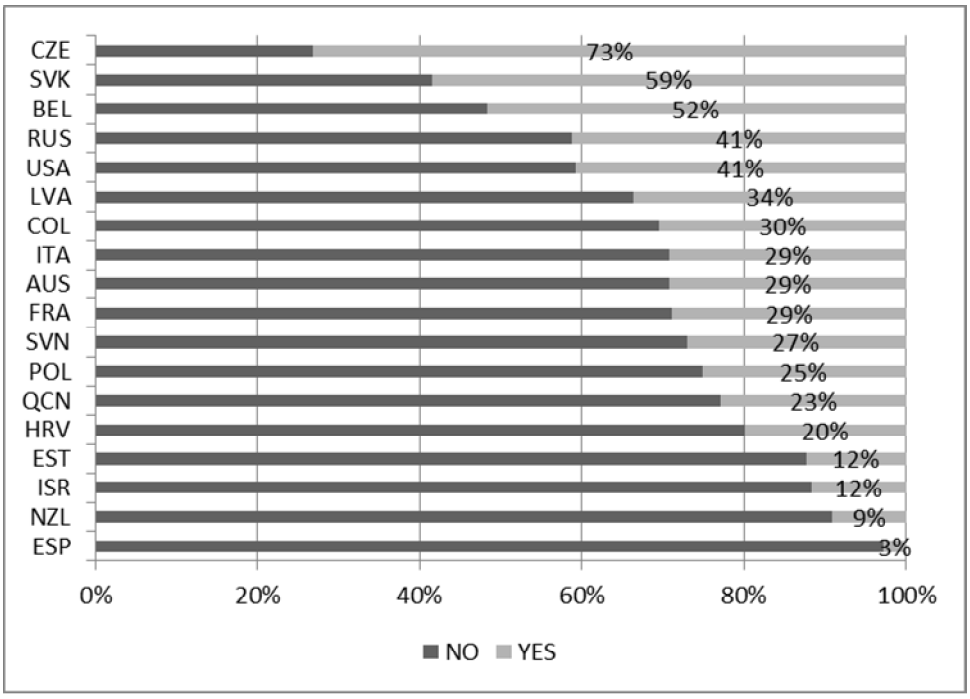
Source: Own elaboration from PISA 2012

Table A1 in the Appendix summarizes the different financial education set-ups in the curricular design of all the countries participating in the PISA 2012 financial literacy test. It also includes information about some pilot programs implemented in a number of countries to incorporate financial competences into the curriculum before they launch a national strategy. For instance, the Spanish and Italian central banks and a number of ministries promoted several experimental programs with the aim of incorporating financial education into school curricula. In contrast, such programs were mainly implemented by private financial institutions in Colombia.

Based on the content of Table A1, as well as the information provided by school principals, we can take a step further and explore different ways of including financial education in the curriculum. Firstly, note importantly that financial education courses are not compulsory in most countries. Exceptions are frequently represented by schools located in specific regions or states where financial education is established as a compulsory subject (e.g. the United States). As a result, the proportion of schools that

can be included in this category is relatively low in most countries, as indicated in Figure 2[2].

Figure 2. Financial education as a compulsory subject by countries



Source: Own elaboration from PISA 2012

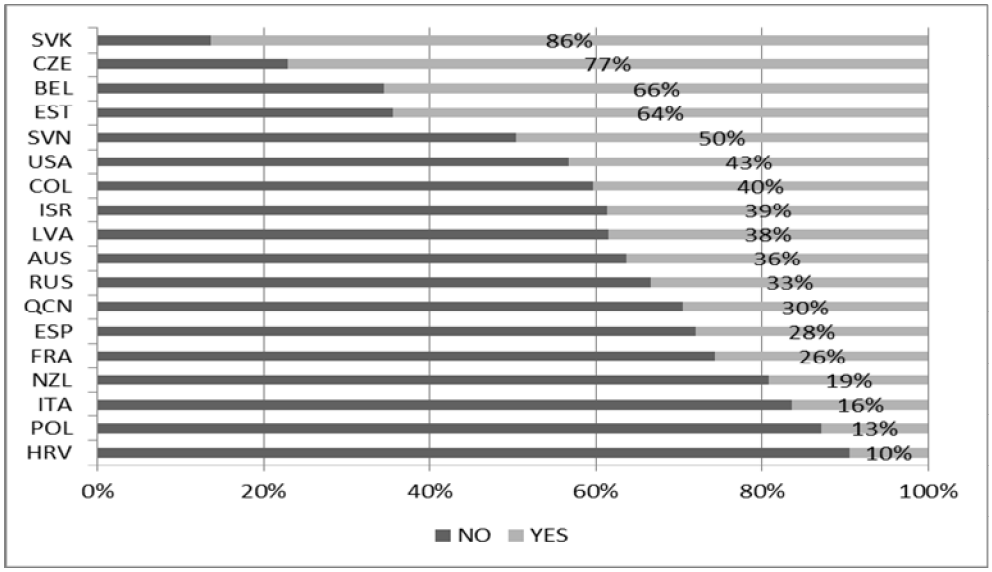
With regard to the manner in which financial education courses are incorporated into the curriculum, the most common option is the cross-curricular approach, i.e., financial concepts are included as a part of other subjects such as mathematics, humanities or social sciences, whereas it is less common for financial education to be taught as a separate subject. Notice again that financial education might be included at different levels of the educational system. Thus we have found that there are several countries where financial education concepts are studied in primary education (Latvia, the Czech Republic, Shanghai-China, Estonia or Australia), whereas they are taught during compulsory secondary education in other education systems (the Flemish Community of Belgium, the Slovak Republic, Israel, Italy or Poland).

Nevertheless, our empirical analysis focuses on the strategies implemented in lower secondary schools since our data source is the information provided by school

[2] The main exception is the Czech Republic where financial education has been compulsory at upper secondary school level since 2009 and at lower secondary school since 2013.

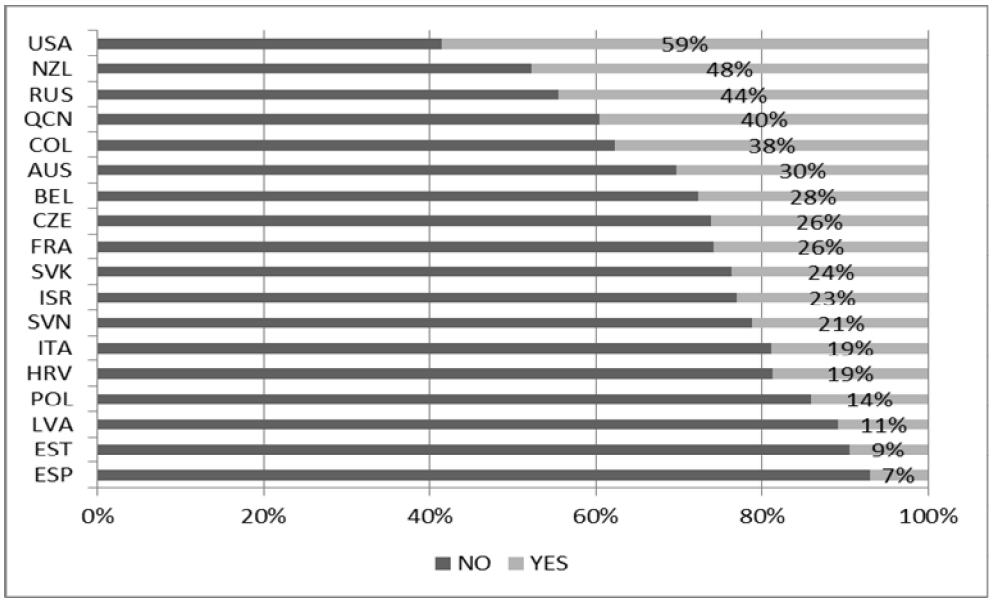
principals participating in PISA as explained below. According to this information, summarized as country averages in Figures 3 and 4, we can identify some countries where the cross-curricular approach is clearly the main alternative (e.g., the Slovak Republic, the Czech Republic or Estonia) and others were the preferred option is to teach financial education as a separate subject (e.g., the United States or New Zealand), although a combination of both strategies is also a common practice (e.g., Shangai-China, Colombia or the Russian Federation).

Figure 3. Financial education using a cross-curricular approach by countries



Source: Own elaboration from PISA 2012

Figure 4. Financial education taught as a separate subject by countries



Source: Own elaboration from PISA 2012

4. Dataset and variables

For the first time, PISA 2012 conducted an assessment of the financial knowledge of 15-year-old students around the world. This was an optional assessment for countries and economies. Eighteen countries and economies participated in the assessment of financial literacy. They include 13 OECD countries and economies: Australia, the Flemish Community of Belgium, the Czech Republic, Estonia, France, Israel, Italy, New Zealand, Poland, the Slovak Republic, Slovenia, Spain and the United States; and five partner countries and economies: Colombia, Croatia, Latvia, the Russian Federation and Shanghai-China. Around 29,000 students completed the financial literacy assessment in 2012.

The students participating in the financial literacy assessment were recruited and assessed separately from and in addition to the other pupils participating in the core PISA assessment (35 per school). In particular, eight additional 15-year-old students were selected randomly from students enrolled in each participating school to take the financial literacy assessment. The test comprised four 30-minute clusters of test material which each student had a total of two hours to complete. Each booklet included two clusters of financial literacy items (a total of 40 questions) that they had to complete in 60 minutes and two clusters of mathematics and reading items including questions very similar to the core assessment. Therefore, data about three different domains (financial literacy, mathematics and reading) is available for this smaller sample of students.

The financial literacy assessment includes three different dimensions: contents, processes and contexts. The content categories comprise the areas of knowledge and understanding that are essential in order to perform a particular financial task. They include money and transactions, planning and management of finances, risk and reward and financial landscape. The process categories refer to cognitive processes and describe students' ability to recognize and apply key concepts in the domain, as well as to understand, evaluate and suggest solutions. Finally, the contexts represent the situations in which financial knowledge, skills and understanding are applied. The focus may be on the individual, family or peer group, the community or the school or even on a global scale.

The PISA dataset also includes a wide range of variables on student background, learning experiences and attitudes drawn from the student questionnaire, as well as data about school resources and policies completed by school principals. Despite the wealth of the available data, we select only a limited number of control variables for student and school background that have proven to have sizeable explanatory power for student achievement in our empirical approach. On the basis of previous evidence about the importance of family educational level and resources (Lusardi and Mitchell, 2007; Van Rooij et al., 2011, 2012), we include the index of socioeconomic background (ESCS[3]) as a covariate. Likewise, we also consider some personal variables such as student age[4] and gender[5], as well as some variables at school level (location in a rural area and the average school ESCS index as a proxy of the peer effect)[6].

Moreover, several questions about students' experience with and behavior in money matters were included at the end of the financial literacy test booklets. The questionnaire covered multiple non-cognitive aspects of financial literacy such as the frequency with which students discuss money matters with parents and friends; sources of money; access to financial products (bank account and prepaid debit card) or decisions in hypothetical spending situations. Although we initially wanted our model to account for this information, we finally had to rule out this possibility because a significant number of the values of the variables derived from such questions were missing because it was only partially implemented[7].

More importantly, school principals provide information in their questionnaire about financial education provision at their school. This is the main focus of this empirical

[3] This is an indicator of the economic, social and cultural status of students created by PISA analysts from three variables related to family background from students' questionnaire: the highest educational level of either of the student's parents, the highest occupational status of either of the student's parents and an index of educational possessions with respect to household economy. We consider that this variable summarizes the socioeconomic status of student households, substituting the usual variables related to parents' occupational status, as well as other proxies of their cultural background or their household conditions (Ganzeboom et al., 1992).

[4] The target population for PISA is students aged between 15 years and 3 (completed) months and 16 years and 2 (completed) months at the beginning of the testing period.

[5] Several studies have detected the existence of gender differences in financial literacy in the young population (Lusardi et al., 2010; Lührmann et al., 2015; Driva et al., 2016).

[6] The theory suggests that the school context is much more relevant as a determinant of students' financial knowledge than other factors such as the media or the characteristics of friends (Pinto et al., 2005).

[7] This questionnaire was split into four parts or booklets. Each part was given to a quarter of the students. Consequently, not all the students answered all the questions, and, therefore, the introduction of this questionnaire would have biased the results.

research. In particular, data include a specific question about whether or not the school provides financial education courses. We can use this information to construct our main variable of interest (*FE availability*). Likewise, school principals also report how financial education courses are taught, including whether they are compulsory for students, or whether they are taught as a separate subject or by means of a cross-curricular approach, i.e., as part of other subjects. Since we are also interested in studying different ways of implementing financial education courses at schools, we have defined several dummy variables according to this information[8]. Table 1 contains the definition of all the variables considered in our empirical analysis, and Table 2 shows the descriptive statistics of all variables.

Table 1. Variable description

	DESCRIPTION
Dependent variable	
Diff. across subjects	Differences in PV between reading and financial literacy
Covariates at student and school level	
Gender	Dummy variable that takes value 1 if the student is a girl
Age	Age of the student
ESCS	Indicator of economic, social and cultural status of students
Rural	Dummy variable that takes value 1 if the school is placed in a village or small town.
ESCS mean	Average value of the ESCS index at school level
Specific variables related to the organization of FE courses	
FE available	Dummy variable that takes value 1 when Financial education is available in the student's school
FE compulsory	Dummy variable that takes value 1 when Financial education is compulsory in the school
FE separate	Dummy variable that takes value 1 if FE is taught as a separate subject
FE cross	Dummy variable that takes value 1 if FE is taught as a cross-curricular subject

Besides variable selection, we should note that the dataset needed to be manipulated for the purposes of empirical analysis in order to avoid the usual problems derived from missing values in some variables. In our case, we apply a multiple imputation method which consists of filling the missing values using an iterative chained equations process

[8] The original information provided by school principals about how financial education courses are taught refers to the number of hours per year, divided into five categories (not at all, 1-4, 5-19, 20-49 and more than 50). Nevertheless, we have only defined two dummy variables (*separate FE* and *cross FE*), denoting that either teaching style is implemented if at least five hours are taught during the year.

(Schaffer, 1999; Royston, 2009)[9]. This method uses all the available variables in the model to estimate unobserved data according to the particular characteristics of each variable[10]. In addition to this procedure, we apply another imputation approach to complete information about our core variable, the availability of financial education courses, based on the responses that school principals give to other related questions. We enacted this procedure after detecting several cases where principals indicate that financial courses were not available, but then they answer to other related questions (e.g., how financial education courses are taught) indicating how financial education is provided in the school. For items where this contradiction was observed, we filled missing data using the responses given to related questions. If we were unable to complete missing values using this procedure, we followed a list wise deletion method. This led to a slight reduction in the size of the original dataset[11].

Table 2. Descriptive statistics

	Mean	Std. Deviation	Min.	Max.
Diff. across subjects	-1.5507	69.2682	-412.74	403.47
Gender	0.4978	0.5000	0	1
Age	15.7850	0.2904	15.25	16.33
ESCS	-0.0809	0.9577	-4.91	3.11
Rural	0.2478	0.4317	0	1
ESCS mean	-0.0809	0.6540	-3.55	1.88
FE available	0.6708	0.4699	0	1
FE compulsory	0.2965	0.4567	0	1
FE separate	0.2592	0.4382	0	1
FE cross	0.3472	0.4760	0	1

5. Estimation strategy

The analysis of the relationship between financial education courses and financial literacy is a complex task because there are certain biases and confounding factors that are difficult to control. For instance, some unobserved characteristics of students such

[9] We opted for the chained equations approach instead of a multivariate normal approach because variables are sometimes nominal and sometimes ordinal.
[10] Using this method we can fill in the missing values using an iterative chained equations procedure with a fully conditional specification of prediction equations. We use all the available variables in the model to estimate unobserved data using three econometric models (logit, ordered logit and multinomial logit) according to the particular characteristics of each variable.
[11] The original dataset was reduced by only 1,253 observations, which is equivalent to less than 5%.

as intelligence, ability, interest in financial matters or previous experiences with money might be relevant factors in determining financial learning (Hilgert et al., 2003; Hastings et al., 2013)[12]. Considering that these variables are hard to measure and thus to account for in a traditional econometric model, the estimated impact of financial education on financial literacy may be biased. Additionally, we have to consider that the assignment of students across schools might not be random when comparing schools where financial education courses are available with schools where they are not. For example, children from families with greater economic and cultural capital are more likely to attend schools with better resources, where this type of financial courses are more likely to be implemented.

In this paper we use a difference-in-differences (DiD) approach in order to address such potential sources of selection bias. This methodology is usually applied when panel data are available. It is thus possible to observe individuals in treatment and control groups at two different points in time (see Schlotter et al. 2011 for details). However, as PISA does not provide data about the performance of students before and after receiving financial education courses, we have adapted this method to an alternative framework where we observe the performance of the same individuals in different subjects. This strategy was originally employed by Jurges et al. (2005) to identify the causal effect of central exams on student performance in Germany using TIMSS data. Other studies have used similar models based on student fixed effects to estimate the impact of teacher characteristics or practices on student performance (Dee, 2005, 2007; Schwerdt and Wuppermann, 2011¸ Bietenbeck, 2014) or the influence of instruction time on academic achievement (Rivkin and Schiman, 2015).

The underlying assumption of our estimation strategy is based on the fact that the treatment, i.e., the provision of a financial education course by the school, has an influence on only one dimension of student performance represented by the scores in the financial literacy test. Therefore, the control group should be represented by students attending schools where this course is not available. Since PISA provides test results for two additional competences, mathematics and reading, we can estimate difference-in-

[12] The literature focusing on the analysis of financial education and financial outcomes has shown that there might be self-selection problems if financial outcomes strongly correlate with cognitive ability (Christelis et al., 2010; Gerardi et al., 2010; Cole et al., 2011).

differences by subject. In particular, we have selected the results in reading for comparison in order to avoid a potential source of endogeneity between achievement in math and financial literacy, since most of the questions in the financial literacy test include algebraic calculations (see OECD, 2014 for details).

In this framework, the estimation strategy consists of separating the sample into students attending schools offering a financial education course and students attending schools where no such course was available. The key assumption required to identify the causal effect is that the difference in both outcome variables would be identical in the absence of treatment. Thus the excess on the difference in the financial literacy test at schools with financial courses should reflect the causal effect of interest.

Formally, our estimator can be described as follows. We consider two different regressions to explain the results in reading (R) and financial literacy (F):

$$y_i^R = \mu_i + X_i\beta + \varepsilon_i^R \quad (1)$$

$$y_i^F = \mu_i + X_i\gamma + C_i\delta + \varepsilon_i^F \quad (2)$$

where μ_i is any individual specific characteristic (e.g. general ability), X_i represents a vector of covariates that might affect the performance in reading and financial literacy in a different way, C_i is a dummy variable for the availability of financial education courses and ε_i^K are error terms. The DiD method basically consists of a subtraction of the equations:

$$D_i = y_i^F - y_i^R = X_i(\gamma - \beta) + C_i\delta + \varepsilon_i^F - \varepsilon_i^R \quad (3)$$

where δ is our parameter of interest. The most relevant advantage of this approach is that the use of differences removes the intrinsic characteristics of each individual (μ_i) from the equation. Thus we are able to control for the most part of heterogeneity represented by innate ability or previous experience at the individual level. This means that each student is serving as his or her control group. This equation will be estimated

using the traditional least squares method. However, we also resort to nonparametric estimation techniques that can detect structures that sometimes remain undetected by traditional parametric estimation techniques since they allow the data to model the relationships among variables. Since our dataset contains a mix of continuous and categorical variables, we apply the local linear nonparametric method proposed by Racine and Li (2004). This method performs better than other nonparametric estimators in the presence of this type of data.

Irrespective of the method selected to estimate the proposed model, the interpretation of parameter $\hat{\delta}$ as the causal effect of financial education courses on financial literacy performance relies on the assumption that the expected value of the difference between both error terms is null: $E[C_i(\varepsilon_i^F - \varepsilon_i^R)] = 0$. This assumption would not be fulfilled if the characteristics of students attending schools offering financial education courses are potentially different from the pupils of schools that do not offer such courses, i.e., if there is a self-selection bias into treatment. We do not think that this problem occurs with our dataset since it is difficult to believe that parents would decide between schools depending on whether or not they offer financial education courses. In order to check this hypothesis, we have calculated the mean differences between both subsamples for a set of student-level variables that have been frequently identified as potential determinants of educational achievement such as gender, age, preschool attendance, socioeconomic background (ESCS), number of books in the household[13], parents' occupational status[14] or absenteeism. Likewise, we have also selected some school variables such as class size, location in a rural area or classroom discipline level. According to the mean values of all these variables shown in Table 3, we can be confident about the assumption that the two samples are comparable, since the distribution of students across schools is very similar for most indicators. Despite these similarities, it is possible to detect a remarkable difference in achievement between subjects (reading and financial literacy). Hence, students obtain almost the same result in reading, but there is a significant difference of 11 points in financial literacy.

[13] Books25 denotes that there are fewer than 25 books in the home, whereas Books200 denotes that there are more than 200 books in the home.
[14] The *Fjob* and *Mjob* variables represent, respectively, whether the father and mother are currently in employment.

Table 3. Differences between two subsamples depending on FE availability

Variable	FE course available		FE course not available			
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean diff.**	**t-test**
READavg	493.374	102.793	493.416	102.164	-0.042	0.030
FLITavg	495.605	103.029	484.484	96.993	11.121	-8.154***
Gender	0.501	0.500	0.496	0.500	0.005	-0.631
AGE	15.791	0.289	15.772	0.291	0.019	-1.153
Preschool	0.931	0.253	0.928	0.257	0.003	0.874
ESCS	-0.079	0.941	-0.083	0.991	0.004	-0.337
Book25	0.330	0.470	0.325	0.468	0.005	-0.753
Books200	0.192	0.394	0.200	0.400	-0.008	1.608
Fjob	0.795	0.409	0.793	0.409	0.002	-0.203
Mjob	0.557	0.497	0.547	0.498	0.010	-1.448
Skipclass	0.393	0.488	0.387	0.487	0.006	-0.902
Rural	0.248	0.432	0.247	0.432	0.001	-0.074
ESCS mean	-0.079	0.639	-0.084	0.684	-0.004	-0.493
Observations	**16,696**		**8,193**			

****p<0.01*

Throughout the following empirical analysis, we make the appropriate adjustment to the estimated standard errors (bootstrapping standard errors by cluster) to account for this clustering of students within schools[15]. Likewise, we have also applied throughout the analysis the weights included in PISA to correct for non-response bias, while also scaling the sample up to the size of the national population (see OECD, 2014 for details). Finally, in the context of a cross-country study, we are also interested in accounting for unobserved heterogeneity across different education systems that might have a different effect across subjects (Hanushek et al., 2014). Therefore, we have also estimated an alternative specification of our model considering country fixed effects.

Finally, as we are interested in studying whether different types of financial education course configurations might have an influence on the financial knowledge learned by students, we use a multiple treatment model in which we include additional dummy variables representing whether or not financial education is compulsory, as well as the manner in which financial education is taught, i.e., as a separate subject or using a

[15] Estimates are bootstrapped by cluster (schools) using 50 replications to calculate approximate standard errors (see OECD, 2014 for details).

cross-curricular approach. These models are also estimated using ordinary least squares and nonparametric techniques in order to ensure more robust results.

6. Results

Table 4 reports the estimates of the model defined in Equation (3) using the ordinary least squares method without (Model 1) and with (Model 2) country fixed effects. The regressions were estimated separately for each pair of five plausible test score values for reading and financial literacy, although the table only reports the mean coefficient estimates and the average of the bootstrap standard errors from the five regressions performed (see OECD, 2014 for details). The results show that the provision of financial education courses has a significant and positive effect on better results in financial literacy. Specifically, participation in financial education courses has the effect of increasing the financial literacy test scores by a standard deviation of 10% over the basic model. The significance of this variable is robust to the presence of country fixed effects, although the value of the parameter drops by approximately two thirds in this case.

We have also estimated this equation using nonparametric techniques whereby it is the data points themselves that determine any dependencies and interactions within the estimated density function, thus they are more robust to functional form specification. Specifically, we apply the local linear nonparametric method developed by Racine and Li (2004) in order to adapt the kernel method to the presence of mixed categorical and continuous data such as we have here. One of the main advantages of this method is that it provides individual significance tests for each of the explanatory variables included in the regression[16]. According to the values reported in Table 5, we observe that our core variable (FE availability) is significant at all conventional levels in the local linear nonparametric model[17].

[16] These tests were proposed by Racine (1997).
[17] The nonparametric estimation of the model was performed in R using the "np" package (Hayfield and Racine, 2007).

Table 4. Least square estimation of the effect of FE courses

	Model 1	**Model 2**
FE available	11.14***	3.76***
	(0.962)	(0.967)
Gender	-34.60***	-34.51***
	(0.7906)	(0.814)
Age	8.85***	7.73***
	(1.581)	(1.389)
ESCS	-1.34**	-1.34**
	(0.696)	(0.571)
Rural	4.16***	5.58***
	(0.956)	(1.003)
ESCS mean	-0.42	-0.34
	(0.947)	(0.995)
Constant	-132.51***	-107.6***
	(25.08)	(22.22)
Observations	24,889	24,889
Country FE	NO	YES
Countries		18
R-squared	0.0716	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Nonparametric significance tests

Variable	p-value
FE available	0.001***
Gender	0.000***
Age	0.004***
ESCS	0.007***
Rural	0.005***
ESCS mean	0.116
R^2	0.1151

While our main focus is clearly on the effect of financial education availability, other parameters in the estimation are also noteworthy. Note that all the individual variables are significantly associated with the differences in test scores across subjects. According to the least squares estimates, test scores in financial literacy are clearly better for boys and older students, while a higher socioeconomic status seems to be related with better results in reading. With regard to covariates at school level, we find that there is a positive and significant relationship for location in a rural area. This is stronger when the model accounts for country heterogeneity (column 2 in Table 4). All these significant relationships are also corroborated by the significance tests performed in a

nonparametric framework. In contrast, the socioeconomic characteristics of schoolmates are not significantly associated with the dependent variable in any of the least squares estimations or when the local linear nonparametric method is applied.

After testing the overall effect of financial education courses on financial literacy, we also estimate some alternative multiple treatment models in order to examine how financial education courses are conducted at schools. First of all, we test whether the configuration of financial education courses as compulsory has an effect on results. Likewise, we also estimate two alternative models considering different ways of teaching financial education concepts: using a cross-curricular approach or as a separate subject. The results of the estimations calculated using least squares with and without country fixed effects are reported in Table 6. Likewise, we run the models using nonparametric techniques and estimate the respective individual significance tests for each variable. Since the values of the tests estimated for our core variable and the covariates included in the regression were very similar to the results shown in Table 5, Table 7 reports only the p-values estimated for the new variables included in the analysis (FE compulsory, FE separate and FE cross).

Table 6. Effect of FE courses depending on their configuration

	Model 3	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
FE available	10.37***	3.103***	11.26***	3.243***	8.632***	2.945***
	(0.922)	(1.025)	(1.029)	(1.226)	(1.024)	(1.013)
FE compulsory	2.035*	1.702				
	(1.085)	(1.172)				
FE separate			-0.306	1.330		
			(1.109)	(1.124)		
FE cross					7.009***	2.676***
					(0.946)	(0.851)
Gender	-34.64***	-34.52***	-34.60***	-34.51***	-34.68***	-34.54***
	(0.653)	(0.868)	(0.847)	(0.815)	(0.784)	(0.813)
Age	8.585***	7.482***	8.859***	7.696***	8.552***	7.712***
	(1.305)	(1.134)	(1.443)	(1.468)	(1.566)	(1.619)
ESCS	-1.286**	-1.284**	-1.343**	-1.341**	-1.345*	-1.342**

	(0.589)	(0.566)	(0.577)	(0.604)	(0.696)	(0.594)
Rural	4.153***	5.632***	4.144***	5.605***	3.920***	5.540***
	(0.879)	(0.832)	(0.895)	(0.880)	(0.960)	(0.892)
ESCS mean	-0.294	-0.174	-0.421	-0.355	-0.330	-0.282
	(0.893)	(1.008)	(0.959)	(0.987)	(0.951)	(0.926)
Constant	-128.4***	-103.7***	-132.6***	-107.0***	-128.5***	-107.7***
	(20.66)	(17.92)	(22.96)	(22.87)	(24.86)	(25.54)
Observations	24,889	24,889	24,889	24,889	24,889	24,889
Country FE	NO	YES	NO	YES	NO	YES
Countries		18		18		18
R-squared	0.0717		0.072		0.074	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7. Nonparametric significance tests for variables related to FE configuration

Variable	p-value
FE compulsory	0.312
FE separate	0.253
FE cross	0.007***

One key finding derived from the estimation of these models is that the effect of financial education is significant in all cases. Moreover, the results suggest that the inclusion of financial education concepts as a part of other subjects, i.e., using a cross-curricular approach, is the only strategy that has a significant effect on improving financial knowledge. In contrast, teaching financial education concepts as a separate subject does not seem to have any impact on students' financial literacy outcomes. Furthermore, the regulation of financial education as mandatory does not appear to have a significant effect either. This evidence is reasonably robust, since the results are very similar irrespective of whether or not the least squares regression and the alternative specifications of the equation estimated using nonparametric techniques account for country fixed effects.

7. Concluding remarks

This paper provides empirical evidence about the effects of implementing financial education at schools as a mechanism for improving young students' knowledge of

financial issues. Our empirical strategy takes advantage of the possibility of exploiting a large-scale international dataset that provides information about different educational outcomes. In particular, we exploit the information provided by the financial literacy and reading tests included in PISA 2012. This is the first initiative that offers such comparable data in an international framework, which allows us to identify a causal effect by adopting a DiD approach comparing the results for two different subjects.

Our empirical findings suggest that the effect of financial education courses is positive and significant irrespective of whether we consider this variable as a single treatment variable or in a multiple treatment model, including some additional variables related to how financial education is implemented. Although the significance of this effect is robust to the consideration of country fixed effects, the effect is clearly smaller taking into account the potential presence of significant differences among countries. This indicates that there are national and cultural differences that policymakers should consider when developing financial literacy assessment tools for their respective countries, as pointed out by Nicolini et al. (2013). More specifically, our results suggest that financial education programs only have an impact on students' financial knowledge if they are taught as a part of other subjects, while the effect evaporates when the program is configured as a separate subject. And the regulation of financial education as mandatory does not seem to have a significant effect either. This contradicts previous evidence about mandated financial education courses in the specific context of the United States (Tennyson and Nguyen, 2001).

Despite these interesting results, there remain some concerns regarding implementation, such as determining the number of teaching hours required in order to obtain meaningful results or examining the different effects of financial education courses depending on whether they are taught during primary or secondary education. Unfortunately, the PISA dataset does not include enough reliable information about these aspects, although the growing development of initiatives and pilot programs involving financial education in multiple countries should allow researchers to make significant progress in developing empirical evidence about these issues in the near future.

Another key aspect regarding the effectiveness of financial education is the training of teachers in order to develop and implement financial literacy programs since there is extensive empirical evidence demonstrating that they exert a decisive influence on student achievement (Hattie, 2009). Regarding this issue, we have managed to identify some successful initiatives in different countries (see Koh, 2016; O´Neill and Hensley, 2016), although most teachers are not properly trained to teach financial concepts because the establishment of financial education courses neither requires nor promotes teacher training in the field (Way and Holden, 2009).

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APPENDIX

Table A1. Situation of FE in countries participating in PISA 2012 financial literacy

Australia	FE is guided by the National Financial Literacy Strategy, a collaborative multi-agency strategy coordinated by the Australian Securities and Investments Commission. The introduction of financial education in Australian schools started in 2005. Financial literacy topics were integrated into school subjects, including mathematics, English and science.
Belgium (Flemish Community)	Learning outcomes for secondary schools (that came into effect in 2010-11) cover typical FE topics, such as budgeting, alongside economics topics, such as labour, goods and services, welfare and poverty. They are mandatory in all secondary schools while schools can decide how and in which subjects these cross-curricular competencies should be integrated.
Colombia*	Law 1450 of 2011 (*Plan Nacional de Desarrollo 2010-2014*), mandated the Ministry of Education to define the set of basic financial and economic abilities that the Colombian school curricula should include. This mandate is being implemented by Decree 457 of 2014. Through this, the government created a multiagency system to coordinate public and private financial education initiatives within the framework of a national strategy for economic and financial education. In the meanwhile, several pilot programs have been implemented by various institutions such as "*Schools for entrepreneurship*", launched by BBVA Colombia in 2012 or "*Financial Education*", promoted by Bancolombia in 2013.
Czech Republic	The introduction of financial education in schools started in 2007 with the definition of the financial literacy standards established by the Ministry of Finance. Subsequently, FE has been made mandatory at upper secondary school level since 2009 and at primary and lower secondary school level since 2013. FE is usually incorporated into various subjects such as Social Studies, Civics, Citizenship Education, Mathematics, or is carried out in some form of project-based learning within the curriculum of these courses.
Estonia	A National Strategy for Financial Literacy started in 2010 and a seven-year national program was launched in 2013. In primary and lower secondary school, monetary and finance-related topics are incorporated in social studies, home economics and mathematics. In general upper-scondary schools financial issues are taught in social studies and human studies under compulsory or elective courses.
France	At the beginning of the 2010 school year, the Ministry of Education reformed the way economics was taught in secondary schools, making the subject compulsory for 15/16 year old students of the general and scientific tracks of French high-schools.
Israel*	Teaching FE in schools started in 2010 with a gradually expanding pilot program for 10th-graders (15- and 16-year-old students). The program deals with a variety of issues, including budget management, the role and importance of banks, loans, savings, investments, and consumer rights. The Ministry of Education is also considering integrating some aspects of financial education in other existing subjects such as mathematics, and Homeland, Society and Citizenship.
Italy*	The Bank of Italy and the Italian Ministry of Education implemented an experimental program to incorporate FE into school curricula through a cross-curricular approach starting in the school year 2008/2009. The program was piloted in selected primary and secondary schools in the first year and then has been extended to a larger number of schools in the following years. Teachers who decide to participate receive training and pedagogical resources from Bank of Italy´s officials.

Latvia	Cross-curricular; financial education is integrated into various subjects of the General Curriculum in primary schools. The basics of economics are an optional subject at general secondary schools. Less than a half are learning economics, finance and business basics at school.
New Zealand	Financial literacy was included in the New Zealand Curriculum in 2009 following a cross-curricular approach. FE provides a context for linking learning areas, such as social sciences, mathematics and statistics, English, business studies, health and technology. Likewise, it also provides a relevant context for strengthening literacy and numeracy skills and understandings, developing the key competencies, and exploring values. Given the self-governing structure of the school system in the country, the school principals have to decide how and to what extent to integrate FE courses.
Poland	In secondary schools, the subject "Introduction to Management of Firms" is compulsory during three courses, 2 hours per week.
Shanghai-China	Some FE topics have been integrated into the existing national curriculum since the 1970s including knowledge about the (socialist) economic system, about budgeting and money management, basic financial services and risks and benefits of financial products. Schools have some autonomy in teaching FE with respect to the national curriculum, thus they can decide to teach additional ones. In the Pudong New Area of Shanghai-China, a regional curriculum called Finance and Money has been delivered since 2001 in 116 primary and lower secondary schools.
Spain*	In the first three courses of Compulsory Secondary Education there is not any specific course related to FE. Some financial contents may be treated under a cross-sectional approach, in courses such as Social Sciences, Geography or History, but from a more historical o geographical point of view. A pilot program was put into place in for the first time during the academic year 2010/2011 for eleven graders (15 years old). The program involved 3,000 students and 70 teachers from 32 schools. The new education law (Organic Law 872013) introduced some contents of financial education as part of Social Sciences area of knowledge.
Russian Federation	In 2011 the Russian government launched a comprehensive five-year nationwide project to support FE and consumer protection. The project targets low-income and vulnerable social groups as well as young people, including school and university students. As part of this project, Russia is preparing its National Strategy for FE to provide a vision and a common framework for the further development of financial literacy policies and programs in Russia.
Slovak Republic	Independently of the track in secondary education, all schools can include in their curriculum optional subjects (maximum load 30%), such as management and entrepreneurship. in all the tracks in secondary education there is an available non compulsory course related to supporting entrepreneurship and management for young people.
Slovenia	Although there is not a compulsory course related to Economics, all schools can offer between 30 and 50% of their curriculum related to financial contents.
USA	Most states have integrated compulsory FE in their curriculum. There are differences across states in whether schools are mandated to offer courses in economics and/or personal finance.

* Countries applying pilot programs to introduce FE in the curriculum.