The effect of Japanese education reforms on the adults' skills

by

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Abstract

This paper examines the effect of the Japanese education reforms of 1980s and 1990s on the performance of adults at the Programme for the International Assessment of Adult Competencies (PIAAC). I use Regression Discontinuity Design to identify if there was a jump in the PIAAC scores of the students who were affected by the reforms, compared to those who were not. Contrary to the public opinion that these reforms had devastating effect on Japanese people, this study shows that although there was a reduction in scores of adults exposed to the reforms, the education level of Japanese people did not decrease dramatically. Moreover, shift to a five-day school week even had a positive effect on the PIAAC scores.

Acknowledgement

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1 Introduction

Asian countries are well-known for their successful education systems, which are believed to be the reason for the outstanding performance of Asian students on various assessment tests. Shanghai, Singapore, Hong Kong, Korea and Japan were ranked top in the most recent Program for International Student Assessment (PISA 2012), and were constantly among top 10 during the previous years.

In May 2014 Pearson Education released its report "Learning Curve 2014", that used the data, gathered by The Economist Intelligence Unit, on the test scores (PISA, TIMSS, and PIRLS)[1], school attendance, teachers' salary and spendings in different countries. Not surprisingly, South Korea, Japan, Singapore and China were at the top of the list, putting particular emphasis on the development of students' numerical skills.

However, among these countries Japan, despite good performance of its students, was notably concerned about its education system and raised the question of reforming it. The phrase "Back to the Basics", meaning back to the disciplined and strict schools, has become popular in aggressive discussions in the political circles and media (Foster (2011)). The reason for this is that Japanese education went through major reforms for the past thirty years and stepped to "yutori education" ("relaxed education" or "education free from pressure") path. Although Japan had been ranking among the top, this reform was still blamed for the decreasing performance and lack of discipline of its students.

It might seem surprising that government was unsatisfied with the results that Japanese students were exhibiting. To shed light on this issue, some researchers explain that Japan, as well as the rest of Asia, is significantly affected by the Confucian culture which places a significantly high value on education (Schneider and Lee (1990), Mason (2014)). From

[1]PISA - Programme for International Student Assessment, TIMMS - Trends in International Mathematics and Science Study, PIRLS - Progress in International Reading Literacy Study

birth Asian children receive the message from their parents that they have to excel in school in order to succeed in life. Therefore, there has always been intense competition among children and each strives to be the best. Not only do they attend school, but they also take private tutoring classes called "juku" in order to overcome severe competition and enter top Universities[2].

After the PISA 2003 results were released and Japan saw some decline in the scores, Japanese government started to implement reforms that would lead to strict education system, so called Basics of 1970s. In 1970s, although Japanese students showed good results on the assessments, society was extremely concerned by the fact that actually the only aim of high school students was to score high on the University entrance examinations. This was a consequence of the unique approach to learning adjusted at school, which consisted of high pressure on students, memorization based education that aimed to make students absorb as much information as possible, rather than reflexively challenging it.

The opponents of this severe high school system argued that Japanese youth is not creative and cannot think out of the box because of the restrictive education methods (Nishimura (2003); Takayama (2007)). The proponents of the existing system said that this kind of education is creating discipline and competitive environment, which in its turn leads to high results of the Japanese youth (Kariya and Rappleye (2010)).

However, the arguments of the opponents were stronger during that period because of the increase in the juvenile delinquency and suicide rates in Japan. During 1973-1976 the suicides that were committed for school related reasons increased from 10.9% to 24.1% for middle school students and from 19% to 23.3% for high school students. Moreover,

[2]According to the statistics of the Ministry of Education, Culture, Sports, Science and Technology of Japan, participation to juku increased from 16% in 1985 to 26% in 2007, and at the lower secondary level, from 44% to 53%. At the upper secondary level the participation rate was close to 70%.

starting from 1965 till 1980 juvenile crime rates were constantly increasing, which created a significant concern about tough education system. This is why government was triggered to implement yutori reforms.

The opponents of this reform blame it for decreasing performance of Japanese students on the assessment tests and refer to the generation that was affected by the reform as "lost generation". The problem, according to them, goes even further than the students' performance, and affects adults' skills and their performance in job places. Moreover, according to some employers, not only does the yutori generation lacks skills necessary for work, but also they are not as disciplined as previous generation, because they belong to "relaxed generation".

Heated discussion on this topic was conducted on political and ideological level, by citing decreasing PISA results and the results of Japanese achievement tests. Although there was an extensive study of the achievement tests, little econometric analysis was conducted on this topic. Most of the existing papers on yutori reforms concentrated on the performance of junior high-school students, on which the reform had only short-term effect. Moreover, although the difference in scores between the yutori and elder generation was noticed, previous analysis does not account for the fact that when students go to study further to upper secondary school and Universities they continue to follow "relaxed education" path. This is why without looking at the effect of the reform on the adults, one would still be ignorant about the reform's full impact. Therefore, contribution of this paper to the existing literature is that it seeks to identify the effect that the waves of the "yutori reforms" had on Japanese adults.

Moreover, analysis of different reforms allows to propose policy recommendations on the possible ways of improving the system. The availability of the relatively fresh data

on the skills of Japanese adults gathered by Programme for the International Assessment of Adult Competencies (PIAAC) allows me to estimate this effect using Regression Discontinuity Design.

The findings from the analysis of different waves of the yutori reforms suggest that there was a negative jump in literacy and numeracy scores after the reforms, which involved reduction of instructional time and change of the curriculum. However, the decrease in scores was not as dramatic with the maximum decrease being 23-24% for numeracy and 19% for literacy tests.

The paper is organized as follows. In the second chapter I describe in more detail the history of Japanese education and the prerequisities for the reform. The third chapter covers the previous studies on the education reforms in Japan. The fourth chapter describes the data and estimation strategy. The fifth chapter presents estimation results. The paper ends with a brief conclusion and possible policy implications.

2 The History of the Japanese education system

The establishment of the modern Japanese education system began in earnest in the latter part of the 19th century. The Japanese took several Western countries, such as the USA and France, as examples and tried to build a new education system that would absorb the best practices of existing ones. Although this process started relatively late, Japan was fortunate enough to have good 'initial conditions' in the form of socio-cultural factors that are explained below[3].

Before the introduction of modern education reform in 1868, Japan had been a closed country for approximately 260 years under the Tokugawa shogunate (1603 - 1868). Suspicious of foreign intervention and colonialism, Japanese society closed off from Western influence, and especially from Christianity. At the beginning of the Tokugawa period there were 300,000 Christians in Japan, but after the repression of their rebellion on the Shibamara Peninsula in 1637-38, Christianity was banned. Confucianism, which with its conservative and strict rules put strong emphasis on loyalty and duty, became the dominant religion. Many experts cite Confucianism as one of the reasons for the success of the education reforms in Japan.

While all trade connections with Western countries, except small Dutch outpost in Nagasaki harbor, were prohibited, Japan at the same time was building a strong relationship with neighboring Korea and China. Thus, there was a traditional East Asian political and cultural order in place.

Although at the beginning of the Tokugawa era literacy rates varied widely by class, by geographic region, and not surprisingly, by gender, as time went on rural people became more and more literate. Moreover, the Tokugawa state was very bureaucratic and

[3]The extensive study of Japanese educational history is given by Research (2003)

all social classes, officials, samurai, commoners, were required to keep detailed records and write a lot of correspondence. Consequently, education was popularized and became much more accessible, so that commoner children could learn in a large number of institutions called "terakoya" ("community learning centers"). In terakoya, students could learn reading, writing and practical skills. Among the samurai, the warrior class that constituted 6 to 7% of population, literacy was almost universal because they had special schools called "fief schools" where they studied the Chinese classics (Confucian doctrine, Chinese literature and Chinese history). And of course, there were special schools for officials. It's also worth mentioning that it was always popular among all social classes to learn some aspects of Japanese culture, such as the tea ceremony, flower arrangement, traditional musical instruments and art. Thus, educational opportunities were by no means monopolized by the elite and Japanese people had common knowledge and common culture, that increased their overall enthusiasm for education. The widespread education of the Tokugawa era built a good base for further Japanese education reforms.

In 1868 there was a political revolution in Japan, the Meiji restoration, that was organized by samurai hostile to the Tokugawa authority because of growing domestic problems and foreign encroachment. They had three main slogans "Civilization and Enlightenment", "Enrich the Country, Strengthen the Military", and "Industrialization" that motivated them to implement major political, economic, and social changes. The Meiji restoration opened the door to modernization and westernization for Japan, but in order to develop and turn into the industrialized country Japan needed a good education system. Although in Tokugawa era people had a reasonable level of education, the education system itself lacked characteristics that should have been found in any modern school system, such as uniformity in terms of curriculum and duration of education, exam-

inations, progression through grades, etc. Thus, immediately after Meiji restoration the leaders of the country decided to create a unified national education system. In 1871, the Ministry of Education was established and in 1872, the new regulation called "Education Ordinance" was introduced. Under this regulation there was a plan to divide the country into eight university districts, each of which would be divided into 32 middle school districts, that would be divided further into 210 elementary school districts. This was done to ensure that the whole nation was receiving appropriate education. Although the plan wasn't fulfilled, there was a large increase in the number of educational institutions: for instance, from 1886 to 1910 their number increased by 6 times.

Undoubtedly, this reform could not be successful unless students would be motivated to learn in the classrooms. In this context the role of teachers increased at that time and much attention was paid to their training and supply. The government established teacher training institutions and invited foreign experts to implement Western models of education. Moreover, Japanese youth went abroad to acquire first-hand knowledge and afterwards came back and taught at Japanese schools and colleges. The reason for this was that teaching was believed to be the "sacred profession" and teachers were highly respected.

After World War II, Japan was occupied by the Allied Forces, that placed it under the control of the General Headquarters of the Allied Forces (GHQ) till 1951. The country was obliged to put forward different reforms like de-militarization, democratization as long as further education reforms. GHQ requested U.S. to direct United States Education Mission to Japan to see how the reforms were implemented. The further post-war education reforms of Japan were carried out on the basis of the recommendations of this mission.

Among the important reforms that were implemented after the war, one was giving the right to create teachers' unions. In 1947 all these unions combined to form a huge and powerful Japan Teachers' Union (JTU). JTU was opposing the government and aggressively put forward the ideas of democratizing and decentralizing the education, which was the first step towards yutori reforms.

Overall, the education system expanded rapidly starting from the 1950s. The extension of compulsory education to 9 years was almost completed and many young people wanted to continue studying. The advancement rate to upper secondary schools stood at 42.5% in 1950, rising to 57.7% in 1960, reaching 82.1% in 1970 and rising to 94.1% in 1980. Although before, higher education was mostly for elite class and in 1960 only 10.3% of the graduating classes entered the University, in 1970 the figure rose to 23.6% and reached 37.4% in 1980. Thus, massification of higher education was becoming a reality for Japan. Moreover, Japanese students were showing impressive results on different assessment tests, ranking highest in mathematics and science. Education was a great trigger for economic and cultural development of Japan. Japanese schools were producing large number of skilled, disciplined and diligent people, who were able to respond to technical changes and innovations.

In spite of this, Japanese education was facing constant criticism as a uniform and rigid system that puts excessive control on children's behaviour. Intensified competition for entering top schools and Universities was referred to as "examination hell". Special attention was drawn to children who were unable to keep up with their lessons, so called "Ochikobore", or the children left behind. In order to be able to catch up with their peers they had to attend private classes at "juku" in the evenings and on the weekends, thus having little spare time. Moreover, in 1970s the phenomenon of "desolation of education"

started to reveal itself: some students refused to go to school because they "disliked it" or because of the in-school violence, bullying and depression. This is why in 1971 the Central Council for Education, an advisory body to the Minister of Education, submitted a report consisting of "a fundamental policy for the comprehensive expansion of the education system". They wanted to improve education at all levels, starting from the kindergarden to the university. Although this attempt was not successful, it opened the way for yutori reforms.

The yutori reform had several major waves. The first wave started in the 1980s when the government revised the teaching curriculum and made it easier so as to reduce pressure and stress that the students were undergoing and to develop their creativity. The second wave took place in 1990s when the policy of Saturdays-off was announced. Starting from 1992 second Saturday of the month was a day-off, and from 1995 every fourth Saturday was announced a day-off for students. The third wave, announced in 1998 and implemented in 2002 introduced five-day school week. Time that used to be allocated to Mathematics and English classes, now was devoted to "comprehensive learning", a cross-disciplinary subject that each school can choose the content for, itself.

However, many experts, education officials and teachers were opposed to these reforms for several reasons. First of all, the scores of Japanese students in PISA and TIMS have decreased and Japan was lower in the ranking tables. Secondly, the discipline and respect to rules, or rather their lack, shown by the yutori generation was another concern. For instance, it became normal for a student not to greet their teachers or to shirk from doing homeworks. This is why in the late 1990's society started to say that education should go "Back to the Basics", to the disciplined and strict education. Nowadays, Japan has created a special Committee for developing new curriculum for the schools and posing strict

rules on the teachers, so that the latter could make students more disciplined. Moreover, Japan considers to shift to a six-day week again. Even if currently Japan began implementing new reforms, it doesn't change much to the students that already graduated from high schools and were directly affected by the reforms. In this context it is interesting to see whether the reforms really had the effect on the generation exposed to them, and that is exactly what this paper seeks to identify.

3 Previous studies of Japanese education reform

There has been little econometric analysis of the yutori reforms, probably due to the lack of data. Most of the existing studies analyzed high school students' performance using internal, Japanese, achievement test results. In particular, Nishimura (2003)[4] argues that more relaxed school education leads to the decreasing enthusiasm and lack of competition among students. He emphasizes the fact that as a consequence of the reform, public schools deteriorated, giving way to the growth of private schools. As private schools put high financial burden on the parents, the socio-economic and cultural backgrounds of the family might become crucial for the future of the child. Thus, it would mean that the idea of "equal education for everyone"[5] that Japan is so proud of doesn't work.

Concerns about equal education were also raised, but from the different perspective, in the study of Kariya (2002). Using the longitudinal Japanese survey, Kariya (2002) shows that the gap between the hard-working students and others increased as a result of the reforms. The reason is that yutori reforms encouraged the idea of realizing each individual's full potential, and this led to a switch from the idea of common education for everyone to the idea of providing different education for various children depending on their potential. This was done by providing a flexible curriculum with more elective classes at the junior high school.

Moreover, Kariya (2002) noted a significant increase in the number of students who answered that they didn't study at all outside school. Students, not obliged to strenuous studies any more, started to shirk and work less, which is unacceptable in the Japanese culture.

[4]Kazuo Nishimura is a chair of the governmental organization "Global Industrial and Social Progress Research Institute" that issued "an urgent educational proposal to halt the scholastic collapse" in 2003. He is one of the most aggressive critics of yutori reform.

[5]This idea is related to the common access to the education institutions

The interesting results were obtained by Nakamura (2012), whose aim was to determine which factors affect the scholastic achievement of students in primary and high schools. Using prefecture-level data for 2007 and 2008 he estimated how school education, studying at home, and parental inheritance affects students. He found that family income, parental education and presence of grandparents have a significant positive effect on students' achievement. The effect of living with grandparents may arise because of the cultural values that are taught by them, as well as their ability to watch and help their grandchildren. Interestingly, government expenditures on education didn't have a significant effect on student performance.

As for the possible long-term social effect of the yutori reforms, Tachibanaki and Yagi (2009) have shown that the decreasing scholastic achievement as well as the widening gap among children during high school education will widen income inequality in the society. Nishimura's idea (2003) about failure of "equal education" was confirmed by Tachibanaki and Yagi (2009), who found that students who are getting into good Japanese Universities, such as Tokyo University, are mainly coming from private high schools, and consequently, from wealthy families. This is why social and academic fracturing are directly related now and will continue to exist in the future, unless the new reforms that could revert this trend are implemented.

Similar results were obtained by Kikuchi (2014), who used Japanese Panel Survey of Consumers, to estimate the effect that the reduction of instructional time during 1980s had on women between 24 and 34 years old. He finds that there was a decrease in schooling by about 0.5 years and the probability to enroll in high school decreased by about 3-4% for women. This effect is coming from the fact that they didn't have as much time as previously to learn the content of the courses with the instructor.

All of the above mentioned papers focused on studying the effect of the yutori reforms on the performance of students at school or the amount of education received. However, the fact that yutori generation is referred to as "lost generation" leads one to think that there was a problem of greater scale than just the high school students' test scores. The analysis of the media news on this issue revealed that the problems goes further in the adulthood of Japanese people. This is why I use the dataset on adults' skills that reveals the long-term effect that the reforms had on yutori generation in their lives after school. The econometric model and the results are presented in the next chapters.

4 Empirical strategy

4.1 Data

The data used in this paper has been collected by the Programme for the International Assessment of Adult Competencies (PIAAC). PIAAC was initiated by OECD to assist governments in assessing, monitoring and analyzing the level and distribution of skills among their adult population. During 2011 and 2012 approximately 166,000 adults aged 16-65 were surveyed in 24 countries, of which 22 are OECD countries and there were two partner countries - Cyprus and the Russian Federation.

The survey assesses the proficiency of adults in literacy, numeracy, reading components and problem solving skills in technology-rich environments. Moreover, the dataset contains background characteristics of the respondents, such as the highest level of education received, education level of parents, immigration status, etc.

I analyze the performance of Japanese adults that were affected by the waves of the yutori reforms. These are people who were 24-36 years old in 2012 when the dataset was collected. The number of observations that I have is 1,844 for each assessment type. However, I had to drop the reading components and literacy (paper based) tests because of the high number of missing values in the dataset. Thus, there will be three dependent variables: literacy (computer-based), numeracy (computer-based) and problem-solving scores. The maximum score for each test was 500 points.

Although in the dataset there is information on immigration status, which could be a good explanatory variable for performance of students, in the sample the majority of individuals were born in Japan. This is why it is not possible to include this variable to the regression. Other factors that could be important for scoring high are rural/urban

origin of the person, income level of the family, however in the dataset there are no such variables. Thus, the available covariates are parents' education level. These variables can take on values from 1 to 3, where

- 1 is ISCED 1, 2 and short 3 – primary, lower secondary and short upper secondary education
- 2 is ISCED 3 and 4 – upper secondary and post-secondary non-tertiary education
- 3 is ISCED 5, 6 and 7 – short-cycle tertiary education, Bachelor or Master's degree

Table 4.1. Summary statistics

	Mean	**Min**	**Max**	**N**
Literacy	300.17	179.89	430.49	1844
Numeracy	246.22	84.75	496	1844
Problem Solving	280.36	204.67	439.61	1844
Mother education	2.29	1	3	1844
Father education	2.28	1	3	1844

Notes: N is the sample size. Summary statistics are based on the individuals born between 1976 and 1988.

Table 4.1 presents summary statistics for the sample used in this paper. The average score among the selected age range for literacy, numeracy and problem-solving skills was approximately 300, 246 and 280, respectively. On average mother's and father's education level was equal to 2, which means that parents had up to the higher secondary education level.

4.2 Regression Discontinuity Design

I use Regression Discontinuity Design (RD Design) to estimate the effect of the Japanese education reform on Japan's performance at PIAAC. This is a very useful tool when dealing with a nonexperimental setting, where the treatment can be defined

by whether some observed variable ("assignment", "forcing" or "running" variable) exceeded a known threshold. RD Design is feasible in cases when the relationship between an assignment variable and the causal variable (the "treatment" variable) reveals a discontinuous jump at a certain cut-off value (threshold). In this paper in order to implement RD Design I draw on theoretical overview of the RD Design provided by Lee and Lemieux (2009) and Lee and Card (2008).

This design was introduced by Thistlethwaite and Campbell (1960) to study the impact of merit awards on future academic outcomes. In this case the merit awards were allocated based on the test scores("assignment" variable) that should have exceeded some threshold.

Although this estimation design was first used 50 years ago, it was not until the late 1990s that RD design became very popular in estimating the program effects in different economic contexts. It is particularly popular in analyzing education, health, labor reforms, and election results.

The main reason for the increasing popularity of RD design is that it delivers more credible estimates than other "natural experiment" strategies, such as difference-in-differences or instrumental variables methods. First, according to Lee (2008) there is no need to assume that RD design is "as good as randomized", because this randomized variation is a direct consequence of agents' inability to manipulate the assignment variable. For instance, in this paper the assignment variable is age of the person which obviously cannot be manipulated and is continuous around the threshold point.

The other compelling feature of RD Design is that it is transparent compared to other methods because it can be illustrated graphically. Graphs are helpful in identifying whether the "jump" at the cutoff value is significantly different from other bumps

in the regression line. Moreover, graphs illustrate results that different functional forms yield.

Third, running OLS regression would likely yield biased estimates if right controls are not included in the regressions and if the assignment variable is correlated with the error term. Obviously, age could be correlated with historical government spending levels on education or economic situation in the country, poverty rate etc. However, in RD Design one just has to ensure that the covariates are continuous around the threshold. The inclusion of the covariates to the regression should not affect RD estimates, but will only decrease the sampling variance. This is another advantage of the RD Design.

In this paper I use sharp Regression Discontinuity, where the receipt of treatment is denoted by the dummy variable $D \in \{0, 1\}$. The assignment variable is age in months. The reason for using months of birth as the assignment variable, and not years, is that this way seasonal differences between individuals born in different months can be controlled for. As it will be explained in section five, there will be different cutoff values for each reform depending on the year of birth of the person. For instance, if we analyze the reform of 1989 when science classes were deleted from the program for the elementary school, it means that those children who were born in 1983 were affected by the reform. Thus, the cutoff year of birth is 1983, this means that the person was 29 years old (or 348 months old) in 2012. In this particular case the dummy D will be equal to 1 if the age of the person is less than 348 months and 0 if it is more than 348 months.

$$D = \begin{cases} 1, & if X < c \\ 0, & if X \geq c, \end{cases}$$

where c is the cutoff value. The causal effect of the treatment is then $\tau_i = Y_i(1)$ - $Y_i(0)$,

where $Y_i(1)$ denotes the potential outcome of i under treatment, and $Y_i(0)$ is the potential outcome of i under control. The treatment effect is then defined as follows

$$\tau_{RD} = E[Y_i(1) - Y_i(0)|X_i = c] = \lim_{X_i \downarrow c} E[Y_i(1)|X_i = c] - \lim_{X_i \uparrow c} E[Y_i(1)|X_i = c] \quad (1)$$

Thus, the simplest way to apply RD Design is to estimate two separate regressions on each side of the cutoff value. For computational convenience it is often suggested to normalize the cutoff value to 0, by transforming X to $X - c$. Consequently, the intercepts of the two regressions will be the values of the regression functions at the cutoff point. On the left-hand side of the cutoff value ($X < c$) the regression will look like

$$Y = \alpha_l + f_l(X - c) + \epsilon, \quad (2)$$

and on the right hand side ($X \geq c$) is

$$Y = \alpha_r + f_r(X - c) + \epsilon \quad (3)$$

The f_l and f_r are functional forms that are applied in the RD Design. In this paper I use the linear, quadratic and cubic functional forms.

The treatment effect is equal to the difference between two intercepts, α_l and α_r. Although this types of regressions can be run, it is often more convenient to combine them and run the pooled regression. It looks like

$$Y = \alpha_l + \tau D + f(X - c) + \epsilon, \quad (4)$$

where $\tau = \alpha_l$ - α_r and *f(X-c)* = $f_l(X - c)$ + D $[f_r(X - c)$ - $f_l(X - c)]$

The reason for using pooled regression is that it directly yields the estimates and standard errors of the treatment effect τ. It is also recommended to include the interaction terms between D and X to have different regression functions on each side of the cutoff value. Then in the linear case the regression function will look like

$$Y = \alpha_l + \tau D + \beta_l(X - c) + (\beta_r - \beta_l)D(X - c) + \epsilon \tag{5}$$

To sum up, in this paper I estimate the linear, quadratic and cubic trends as in (4), and linear, quadratic and cubic splines as in (5). The dependent variables are literacy, numeracy and problem-solving scores of an individual, the assignment variable is age and the cutoff value is determined conditional on the timing of the reform. I also check if the other covariates, such as mother's and father's education level are continuous, and if their inclusion into regressions yield similar estimates.

5 Estimation results

5.1 Effect of the first wave of the reforms - 1980s

During the 1980s there were extensive discussions about changing the education system that resulted in a major reform in elementary school: in 1989 in the lower years of the elementary school, science and social studies classes were abolished and the curriculum became easier. Children in Japan enter grade 1 of elementary school at the age of 6, this is why those children who were born after January 1, 1983 were fully affected by the reform. According to the National Council on Educational Reform of Japan, those students who started in the old system switched to a new one two years after. This is why it is possible to use a two-year window for the cutoff value. Taking into account that before the reform in Japanese schools a lot of accent was put on the mathematical and science skills, the reform should have had an effect on the level of adults' skills.

Table 5.1 provides estimates for the impact of this reform on PIAAC scores. The rows show τ's using alternative polynomial trends. From the Table 5.1 it can be seen that children born after January 1, 1983 scored between 26 and 29 points less in literacy tests, which constitutes an 8-9% decrease of the average score for the sample. The numeracy column reveals a decreasing performance in numerical test by 57 - 69 points (18-22% decrease) of the children born after 1983. The estimates for literacy and numeracy scores were significant at 1% level. However, there was no discontinuity observed in problem-solving scores with the insignificant estimates of relatively small size.

The results for numeracy test are consistent with our understanding of the reform, which decreased numeracy-involving classes. As for the literacy scores, the effect is consistent with the results of the survey that was conducted on school children born between

1980 - 1986 and revealed that they did not read much because of the more relaxed education (Takayama, 2007).

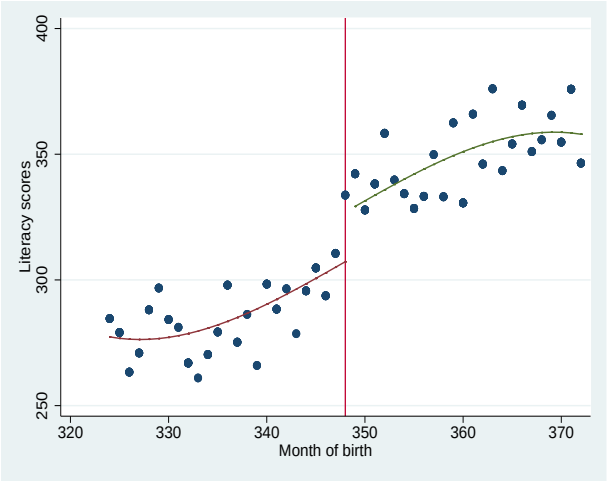
The examination of the sample PIAAC tests shows that the problem-solving test was quite basic, asking, for instance, to search for a vacancy on the website or for some other information. This is why it is a little surprise that the scores were smooth across the sample.

Table 5.1. Estimates of the 1989 educational reform on PIAAC scores

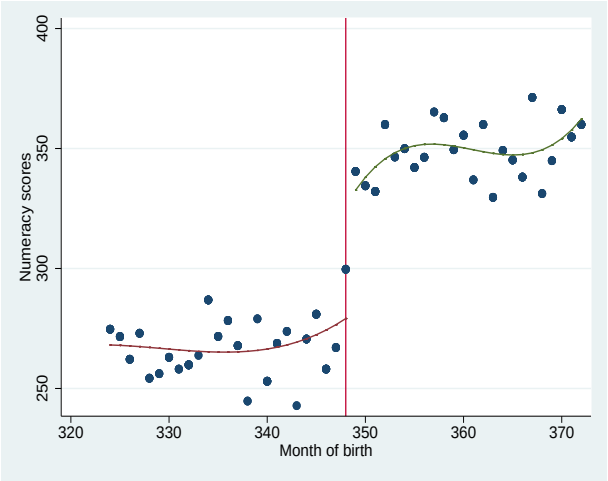
Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	-29.202***	-69.433***	-8.551
	[2.553]	[2.457]	[6.158]
Quadratic	-29.214***	-69.655***	-8.495
	[2.573]	[2.284]	[5.159]
Cubic	-29.766***	-65.256***	-6.879
	[3.495]	[2.990]	[4.881]
Linear spline	-29.090***	-69.559***	-8.525
	[2.508]	[2.472]	[5.166]
Quadratic spline	-28.627***	-62.443***	-8.103
	[3.429]	[3.351]	[5.660]
Cubic spline	-26.953***	-57.004***	-6.661
	[4.638]	[4.488]	[5.630]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	319.263	311.161	350.424

Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10 % level respectively. Sample includes people who were born between January 1, 1981 and December 31, 1985. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1983 and 0 for individuals born on or before December 31, 1982.

(A) Literacy scores



(B) Numeracy scores



(C) Problem-solving scores

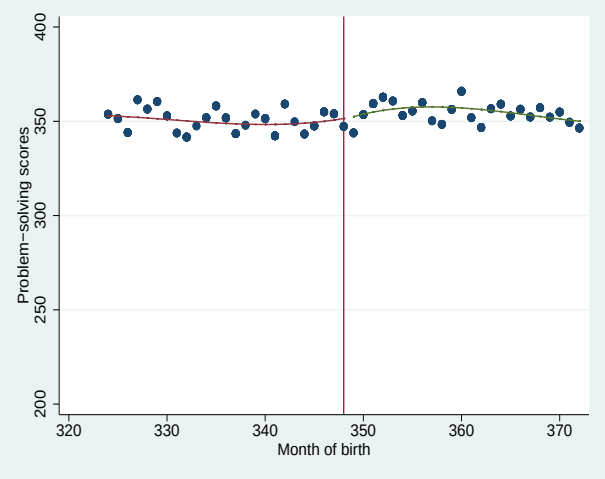


Fig. 5.1. PIAAC scores for individuals born between January 1, 1981 and December 31, 1985.

In 2012 those people who were born in 1983 were 29 years old, which translates to 348 months, the cutoff point. Fig 5.1 plot the scores for each test by month of birth. Panels (A), (B) and (C) show sharp discontinuity for literacy and numeracy scores and smooth problem-solving scores. Thus, the net effect of the 1989 reform was negative for literacy and numeracy scores, but had no effect on the problem-solving scores.

5.2 Effect of the second wave of the reforms: 1990s

Having established that indeed even the first steps of the yutori reforms have had an impact on the performance of adults, I consider the effect of the next reforms that took place in 1990s.

From 1992, schools closed on the second Saturday of every month and from 1995, they closed on the fourth Saturday as well. Thus, students had two Saturdays off per month. Moreover, new Curriculum was announced in 1998 for elementary/lower secondary schools. The teaching hours for Grade 6 of the elementary school were reduced from 1015 to 945 hours, and for Grade 3 of lower secondary school from 1050 to 980 hours. The curriculum for elementary school was cut by 30%. One-year windows were used because the reforms were implemented for the whole system and students did not follow their previous tracks after the reforms. This might create some concern about the robustness of the results, however, robustness is checked by higher-order polynomials inclusion, and in a way automatically because reforms were pairwise similar, so that 1992/1995 reforms led to Saturdays-off and 1998/1989 reforms concentrated on elementary school children. Table 5.2 shows the cutoff values and windows for each reform

Table 5.2. Cutoff values and windows for the 1990s reforms

Reform	Cutoff age in years	Cutoff age in month	Window	Explanation
1992	35	420	408 - 432	Children who entered high school in 1992
1995	32	384	372 - 396	Children who entered high school in 1995
1998	25	300	288 - 312	Children studying at the 6th Grade of the elementary school in 1998

The estimates of the Saturdays-off reforms (1992 and 1995) are presented in Tables 5.3 and 5.4. It seems surprising that all the estimates have a positive sign, which means

that the performance of students who were born after January 1, 1992 and January 1, 1995 actually improved compared to students who studied during Saturdays. However, a study by Anderson and Walker (2015) has shown that even four-day school week might bring positive changes to children performance. As such, both reading and mathematical scores increased in Colorado in 2000-2010, with the scores on mathematical achievement tests increasing by more than 12% after the switch to four-day-week schedule. The reason for this effect is that students benefit more and recover better when they have whole day off, compared to additional spare time during the week. Moreover, it is also pointed out that high school students have more flexibility for adjusting their part-time job schedules to allow enough time for studying.

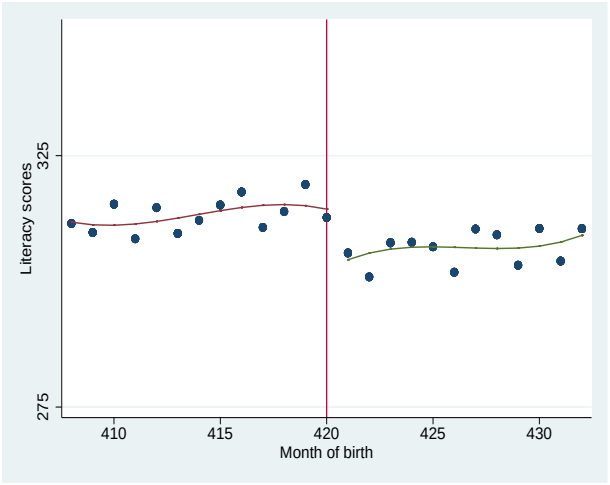
Table 5.3. Estimates of the 1992 educational reform on PIAAC scores

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	10.523***	38.497***	-3.431
	[0.704]	[2.024]	[3.022]
Quadratic	10.510***	38.294***	-3.473
	[0.743]	[2.130]	[3.220]
Cubic	10.333***	38.955***	-8.535
	[0.989]	[2.290]	[5.618]
Linear spline	10.477***	37.824***	-3.567
	[0.706]	[1.796]	[2.953]
Quadratic spline	10.189***	41.327***	-2.849
	[1.102]	[3.227]	[2.385]
Cubic spline	12.030***	38.317***	-3.884
	[1.288]	[3.107]	[3.094]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	309.953	311.161	248.808

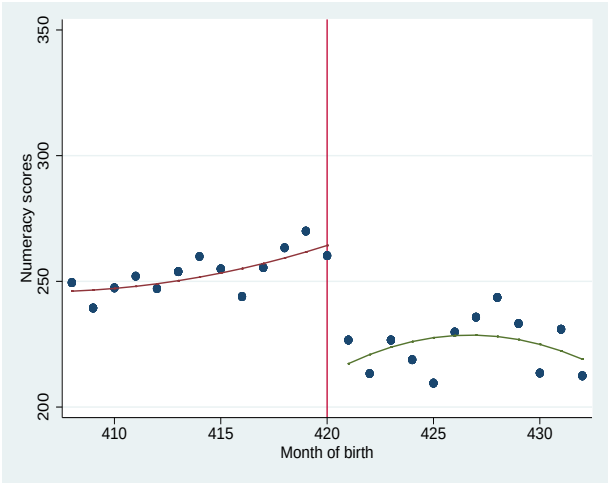
Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1976 and December 31, 1978. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1977 and 0 for individuals born on or before December 31, 1976.

In Japanese context, the 1992 reform led to an increase by 10-12 points (3.2-3.9% of average score for subsample) for literacy and by 38-41 points (12.2-13.2% of the average score for subsample) for numeracy tests. In turn students affected by 1995 reform performed 26 - 31 points (7.8-9.4%) higher in literacy and 39 - 45 points (11.36-13.1%) higher in numeracy tests. As before the problem-solving test scores did not have any discontinuity. Fig.5.2 shows sharp discontinuity in literacy and numeracy scores, and smoothness of the problem-solving scores for 1992 reform.

(A) Literacy scores



(B) Numeracy scores



(C) Problem-solving scores

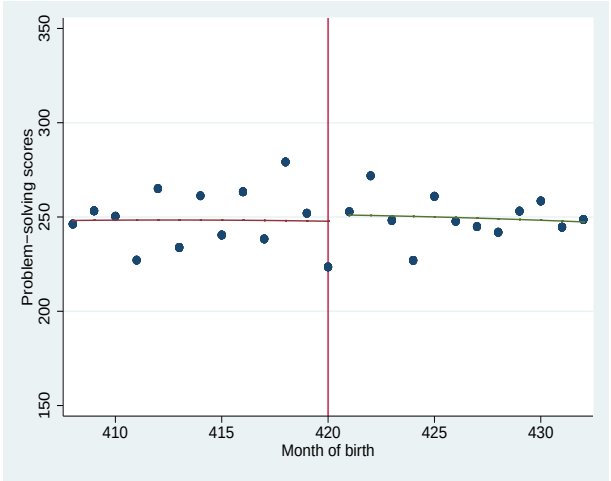


Fig. 5.2. PIAAC scores for individuals born between January 1, 1976 and December 31, 1978.

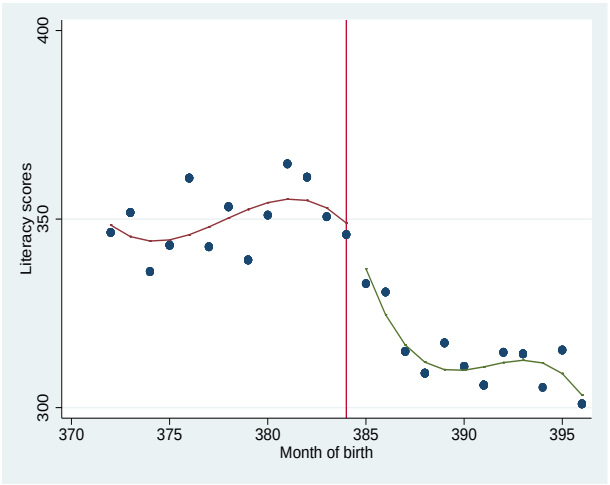
Table 5.4. Estimates of the 1995 educational reform on PIAAC scores

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	34.190***	45.385***	2.285
	[2.962]	[3.868]	[1.641]
Quadratic	33.212***	44.045***	3.287
	[2.454]	[3.275]	[2.972]
Cubic	30.609***	41.141***	5.011
	[3.496]	[4.957]	[3.701]
Linear spline	31.988***	42.956***	4.015
	[2.382]	[3.966]	[3.213]
Quadratic spline	32.349***	37.377***	4.780
	[3.540]	[6.545]	[3 .408]
Cubic spline	31.052***	39.027***	5.237
	[4.990]	[7.132]	[3.256]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	331.423	343.412	255.18

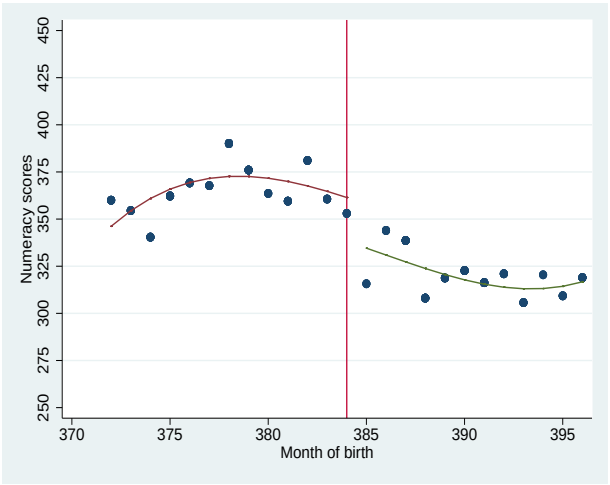
Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1979 and December 31, 1981. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1980 and 0 for individuals born on or before December 31, 1979.

The results for 1995 reform show that the positive impact of Saturday-off reforms becomes even higher with the additional free Saturday. The Panels of Fig. 5.3 exhibit a positive jump in literacy and numeracy tests. Due to the lack of sufficient data it was not possible to analyze the reform of 2002 when Japan's schools totally switched to five-day school week. However, it could be done in the future research for robustness check.

(A) Literacy scores



(B) Numeracy scores



(C) Problem-solving scores

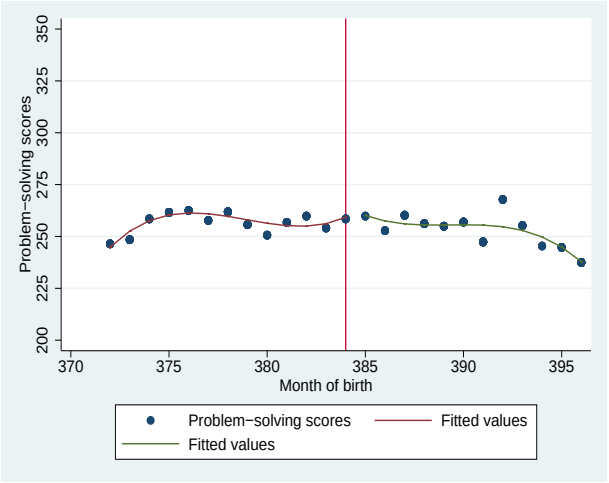


Fig. 5.3. PIAAC scores for individuals born between January 1, 1979 and December 31, 1981.

I proceed to examine the effect of the 1998 reform. As it was previously mentioned the reform of 1998 was related to elementary school students and this is why it is reasonable to assume that the change of the curriculum from the elementary classes might have had an effect on the scores because these children were fully integrated into new system.

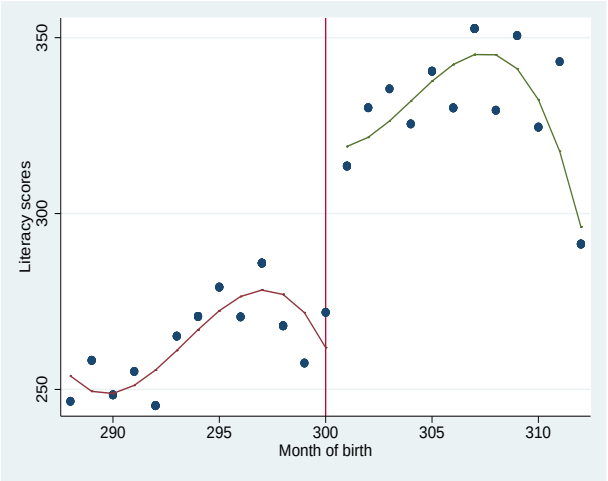
Table 5.5. Estimates of the 1998 educational reform on PIAAC scores

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	-52.423***	-49.492***	4.477
	[4.184]	[2.923]	[4.742]
Quadratic	-56.037***	-48.547***	7.196
	[4.379]	[2.921]	[4.843]
Cubic	-54.830***	-50.139***	6.941
	[6.095]	[3.674]	[5.009]
Linear spline	-56.151***	-47.968***	7.309
	[5.118]	[2.614]	[4.764]
Quadratic spline	-55.168***	-50.715***	4.267
	[3.542]	[4.018]	[3.048]
Cubic spline	-57.542***	-48.346***	3.123
	[6.086]	[4.735]	[2.277]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	287.562	204.016	286.763

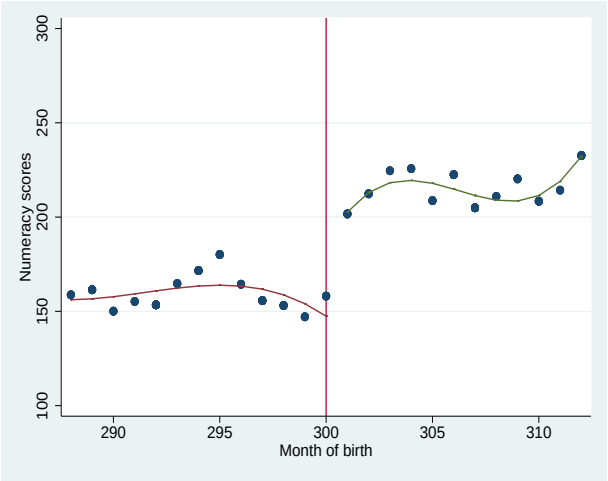
Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1986 and December 31, 1988. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1987 and 0 for individuals born on or before December 31, 1986.

Indeed, there was a sharp drop in the literacy and numeracy scores, with the decrease amounting to 52 - 57 points (18-19% of the average score) for literacy test and 48 - 50 points (23-24% of the average score) for numeracy test. The Fig.5.4 also exhibits the discontinuity at the cutoff point.

(A) Literacy scores



(B) Numeracy scores



(C) Problem-solving scores

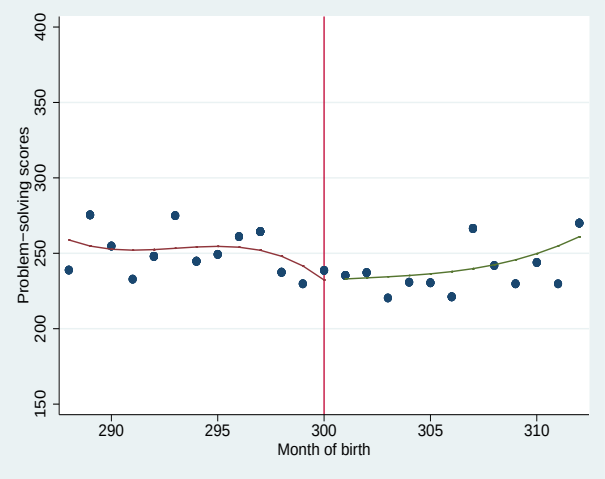


Fig. 5.4. PIAAC scores for individuals born between January 1, 1986 and December 31, 1988.

Overall, the results show the negative effect of the reforms, which included reduction of instructional time and curriculum changes that were implemented in 1989 and 1998. The 1989 reform resulted in a 8-9% decrease in literacy and an 18-22% decrease in numeracy scores. The 1998 reform led not only to the cutting of the curriculum, but also to the reduction of the instructional time. Thus, it had more impact on the scores of individuals than the reform of 1989, with literacy scores decreasing by 19% and numeracy scores decreasing by 23-24%. Interestingly, the Saturday-off reforms had a positive effect on the

scores of the individuals. For those students who were affected by the 1992 reform the literacy scores increased by 3.2-3.9% and numeracy scores increased by 12.2-13.2%. Second Saturday-off generated even more effect with literacy scores increasing by 7.7-9.4% and numeracy scores increasing by 11.36-13.1%. Including higher-degree polynomials, splines as well as covariates (see Appendix) does not change the results significantly. This is why the results obtained are robust.

6 Conclusion

This paper has examined the effect of different waves of yutori reforms in 1980s and 1990s on the performance of Japanese adults at the Programme for the International Assessment of Adult Competencies. To identify this effect I used Regression Discontinuity Design, showing that the different reforms affected the PIAAC scores in a various way. First, the reforms of 1989 and 1998, which were related to the reduction of instructional time and change in the curriculum in the elementary schools, had a significant negative impact on the literacy and numeracy scores of the individuals, while the impact on problem solving skills was insignificantly small. Second, Saturday-off reforms of 1992 and 1995 had a positive effect on the scores, which is a consequence of arising opportunities for students to adjust their time properly and recover after the school week.

Several limitations are worth mentioning: first, the number of observations is small in the age groups, this is why analysis involving more observations could yield more credible estimates. Second, due to the lack of sufficient data it was not possible to analyze the effect of the 2002 reform that eventually led to a five-days school week; the effect of this reform could be a good robustness check for the estimates obtained for other Saturday-off reforms.

Based on the obtained results several policy implications may be suggested. First, five-day school weeks have a positive effect on the performance of individuals and this is why the idea of the return to six-day school weeks that Japanese government wants to implement might need some reconsideration. Moreover, as Japan is returning back to a tough education system, it might be even more difficult for students to keep up with the school programme, which eventually will affect their future. Second, the return to more demanding curriculum might have a positive effect on the performance of Japanese adults

in future, as previous reforms led to the decreasing performance by relaxing the curriculum. Thus, this study suggests that it is more important to pay attention to qualitative reforms such as curriculum change, rather than returning to the six-day school week.

Given that the triggering factors for implementing yutori reforms were suicide, bullying and violence rates among youth in the country, Japanese government, while returning "Back to the Basics", might consider weighing these factors against potential improvements in the test scores that will be achieved at the cost of additional stress and health problems of youth.

Appendix

Tables

Table 6.1. Estimates of the 1989 educational reform on PIAAC scores with covariates

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	-28.945***	-69.427***	-8.185
	[2.555]	[2.459]	[6.297]
Quadratic	-28.952***	-69.667***	-8.228
	[2.574]	[2.465]	[5.823]
Cubic	-29.157***	-65.093***	-6.392
	[3.507]	[3.005]	[2.838]
Linear spline	-28.835***	-69.561***	-8.679
	[2.511]	[2.473]	[5.009]
Quadratic spline	-28.121***	-62.239***	-8.468
	[3.453]	[3.377]	[5.600]
Cubic spline	-26.498***	-56.808***	-7.011
	[4.648]	[4.503]	[5.173]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	319.263	311.161	350.424

Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10 % level respectively. Sample includes people who were born between January 1, 1981 and December 31, 1985. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1983 and 0 for individuals born on or before December 31, 1982.

Table 6.2. Estimates of the 1992 educational reform on PIAAC scores with covariates

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	10.543***	38.515***	-3.427
	[0.703]	[2.033]	[4.052]
Quadratic	10.530***	38.279***	-3.476
	[0.706]	[2.130]	[3.212]
Cubic	10.397***	38.961***	-8.592
	[0.994]	[2.329]	[5.684]
Linear spline	10.501***	37.803***	-3.577
	[0.706]	[1.823]	[3.983]
Quadratic spline	10.282***	41.323***	-2.920
	[1.199]	[3.272]	[2.448]
Cubic spline	12.078***	38.412***	-3.799
	[1.700]	[3.170]	[3.764]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	309.953	311.161	248.808

Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1976 and December 31, 1978. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1977 and 0 for individuals born on or before December 31, 1976.

Table 6.3. Estimates of the 1995 educational reform on PIAAC scores with covariates

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	34.523***	45.557***	2.082
	[2.998]	[3.921]	[1.659]
Quadratic	33.510***	44.169***	3.126
	[2.503]	[3.279]	[2.104]
Cubic	30.856***	41.231***	4.894
	[3.517]	[5.010]	[3.726]
Linear spline	32.266***	43.067***	3.966
	[2.437]	[4.033]	[3.273]
Quadratic spline	32.586***	37.532***	4.805
	[3.557]	[6.994]	[3.399]
Cubic spline	31.943***	39.134***	5.219
	[5.003]	[7.540]	[3.242]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	331.423	343.412	255.18

Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1979 and December 31, 1981. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1980 and 0 for individuals born on or before December 31, 1979.

Table 6.4. Estimates of the 1998 educational reform on PIAAC scores with covariates

Coefficient on D (τ)	**Literacy**	**Numeracy**	**Problem-solving**
Linear	-53.008***	-49.989***	4.254
	[4.184]	[2.923]	[4.905]
Quadratic	-57.287***	-48.914***	7.313
	[4.379]	[2.921]	[3.994]
Cubic	-56.158***	-50.212***	6.972
	[6.095]	[3.674]	[4.976]
Linear spline	-56.360***	-48.282***	8.515
	[5.118]	[2.614]	[3.904]
Quadratic spline	-55.268***	-50.805***	4.268
	[3.542]	[4.018]	[3.227]
Cubic spline	-57.530***	-48.028***	3.205
	[6.086]	[4.735]	[2.381]
Cal.month dummies	Y	Y	Y
Mean of dep.variable	287.562	204.016	286.763

Notes: Robust standard errors are included in brackets. ***, ** and * indicate statistical significance at 1, 5 and 10% level respectively. Sample includes people who were born between January 1, 1986 and December 31, 1988. Each cell corresponds to a separate regression and presents the coefficient on D in Eq. (4) and(5). D is defined as 1 for individuals born on or after January 1, 1987 and 0 for individuals born on or before December 31, 1986.

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