The Impact of Spending on Early Childhood Education and Care on PISA Scores

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Thomas van Huizen
Yusuf Emre Akgündüz

Utrecht University School of Economics

Abstract

This study examines the impact of public spending on Early Childhood Education and Care (ECEC) on age 15 achievement using PISA 2012 data. In order to estimate the causal effect of ECEC spending on student test scores, we follow a cross-country instrumental variable approach. Our identification strategy exploits between country variation in effect of World War 2 (WW2) on female labour force participation. The war had a direct effect on governments' involvement in childcare as the home front required more women to enter the labour market: the 'shock' in female labour force participation during WW2 appears to have generated persistent differences in ECEC coverage and spending. Our results show that ECEC spending significantly improves student achievement in reading but not in mathematics. Moreover, the positive effects are concentrated within boys and within students from families with higher socio-economic status.

Introduction

There is a growing consensus that the early years matter critically for child development and later life outcomes (Elango et al., 2015; Duncan & Magnuson, 2013). According to recent models on the technology of human capital formation, early learning is the foundation for later learning, that is "skills beget skills" (Cunha & Heckman, 2007). This suggests that that investments in education have especially high returns when children are young (e.g. Heckman & Masterov, 2007). Although in OECD countries a considerable and growing number of children participate in Early Childhood Education and Care (ECEC)[1], significant variation between developed countries – even within the European Union – remains. Cross-country differences in coverage rates is especially striking for the younger children: over 50 percent of children aged 0 to 2 are enrolled in ECEC in the Denmark, Norway and the Netherlands, whereas the enrollment rate of this age group is less than 20 percent in Austria, Greece and most Eastern European countries (OECD, 2015a). Related to that, public spending on ECEC varies significantly from one country to another, with some countries spending more than 1 percent of GDP on ECEC (with about 2 percent, Denmark is the biggest ECEC spender) and others about half a percent or less (e.g. Austria, Poland) (OECD, 2015b).

The primary goal of this paper is to test whether ECEC investments affect longer term cognitive development and help explain the cross-country variation in PISA scores. While childcare was traditionally seen as a policy instrument to promote female employment, it is now recognized that ECEC has the potential to improve cognitive and non-cognitive development (Elango et al., 2015; Melhuish et al., 2015). Given the variation and the fact that several countries have substantial room to increase spending on ECEC, we examine whether it pays, in terms of longer term human capital outcomes of participating children, to increase spending on ECEC? The PISA study presented by the OECD shows the high degree of cross-country variation in test scores of pupils across OECD and partner countries. Research has shown PISA and other international test scores like PIAAC to be strongly linked to important later life earnings, which gives policymakers a strong incentive to focus on education reforms that are shown to raise test scores (Hanushek, 2011; Hanushek et al. 2015).

The fundamental problem in a cross-country analysis of the impact of any institutional variable on test scores is endogeneity. One prominent solution is to make use of historical variables that are presumably exogenous from current test scores to instrument an institutional feature of a country (Hanushek and Woessman, 2010). There are a number of unobservable differences between countries that may explain both performance in test scores and the level of ECEC investments. Our approach to this endogeneity problem is to exploit the potentially exogenous variation in the institutional path of ECEC development across OECD countries. Since government involvement in

[1] About one third of children aged 0-2 and over 80 percent of children aged 3-5 participate in ECEC (OECD, 2015).

ECEC dates back to the start of the rise in female employment during World War 2 (WW2), we use the variation in the change in female employment rates during WW2 across OECD countries to instrument ECEC spending (Kamerman, 2007).

We find that country level ECEC spending during the years relevant for the PISA 2012 sample is predicted strongly by the cross-country differences in changes in female employment rates during WW2, even after a number of other country level controls are included including the female employment rate prior to WW2. The predicted ECEC spending then turns out to have a positive effect on PISA reading performance in 2012. However, the effects for mathematics scores are insignificant.

The findings have implications for two strands of the education literature. Due to endogeneity concerns, most recent studies rely on either relatively small scale randomized controlled trials (Heckman 2006) or natural experiments based on country specific reforms (e.g. Black et al. 2014; Felfe et al. 2015; Havnes and Mogstad, 2011) to identify the effects of ECEC on child development. This is the first paper to our knowledge that attempts to estimate a causal effect of ECEC investment and later life test scores using cross-country variation. Furthermore, this study examines the effect of country level spending on ECEC: this provides a different perspective on the impact of ECEC policies than most other studies that examine the effect of participation in ECEC. Our study also adds to the literature on the cross-country analyses of PISA scores that have previously analyzed institutional factors about primary and secondary schools such as competition, school autonomy and population density (Hanushek and Woessman 2006; Hanushek and Woessman 2013; Lounkaew 2013).

The rest of the paper is structed as follows. Section 2 introduces the theoretical framework. Section 3 discusses the history of childcare across OECD countries and the significance of WW2 in jumpstarting government involvement in ECEC. Section 4 presents the empirical methodology. Section 5 provides descriptive on the data used. Section 6 shows the results. Section 7 concludes.

WW2 and the development of ECEC

In order to estimate the causal effect of public ECEC spending on PISA test scores, we exploit the fact that the World War 2 affected female participation rates, which generated persistent differences in the ECEC infrastructure across countries. Below we discuss the mechanisms that link historical ‘shocks’ in female labour force participation to present day investments in ECEC.

ECEC services date back to the 19th century but the large scale government involvement in childcare is largely a product of the 20th century. Kamerman (2006) reviews the historical development of ECEC services and concludes that European countries had ECEC beginning in 19th century to respond to needs of neglected children needing protection and as a tool to enrich the development of children of middle class families. With World War II, the reason for the demand changed to responding the need for non-parental care due to the rise of female labour force participation. Parallel with trend

of rising female labour force participation during the second part of the 20th century, the use of ECEC services rose most markedly between 1960 and 1995 in Europe. In 2002 the Barcelona targets were set for 2010, which include benchmarks for childcare coverage: Member States should strive to provide ECEC services to at least 33 percent of children aged 0 to 2 and 90 percent of children aged between 3 and the mandatory schooling age. However, in 2010 only 10 Member States met the target for the younger age group and 11 Member States met the target for the older age group (Mills et al., 2014). Although one may expect that setting a general target may lead to harmonization of social policies, this indicates that large differences remain between countries in coverage rates and therefore also the spending levels on ECEC (coverage rates are highly correlated to public spending on ECEC, see next section). These differences appear to be especially pronounced for younger children as many countries already have high rates of coverage for children aged older than 3.

The World War II had a direct effect on governments' involvement in childcare as the home front required more women to enter the labour market. The relationship between the need for female employment and war has previously been used to instrument female labour force participation to study female employment and child development in the United States (Fernandes et al., 2004; Herbst, 2015). The Lahnam act of 1940 provides a prime example of public involvement due to World War II, whereby the federal government provided funding for childcare programmes to allow for increasing female employment. The United States is not the only country to have public involvement in childcare provision due to the increased demand for female employment generated by the war. The United Kingdom passed the Family Allowances Act in 1945, which provided cash payments to mothers for each child in their care, marking the first time in which government money was paid directly to women rather than men. In a smaller scale, Canadian women in wartime industries could benefit from subsidized childcare through the Dominion-Provincial Wartime Agreement that was in force between 1942 and 1946. Even in countries that were less directly involved in the war, government involvement in childcare provision coincides with the war. In Sweden, public childcare provision was first introduced in 1944 and the providers became known as daycare centers rather than creches (Gurnarsson et al. 1999).

Female labour force participation did not rise in all countries during WW2. The willingness of the governments to provide childcare where it did appears to have generated persistent differences in ECEC coverage and spending. The persistence of the differences from a shock from 50 years ago is in line with the hypothesis of path dependence in welfare state policies (Hacker, 2004). Fundamental shifts in social policies are unlikely and the initial difference in starting positions due to differences in responses to WW2 can partially explain the differences in ECEC coverage and spending across OECD countries.

Clearly, the rise or decline in female labour force participation during WW2 will not have only affected childcare policy in a country. In order to isolate its effect on childcare policy, we will include several country level control variables. First, we control for pre-WW2 female participation, which

might be both correlated with a country's development level and the change in participation during WW2. Second, as a likely alternative pathway other than ECEC infrastructure runs through present day female labour force participation, we control for current female labour force participation using both individual (i.e. the mother's employment status) and country level (i.e. the labour force participation rate) variables. As expected, Finally, we control for spending on education and the current GDP per capita, neither of which appear to be correlated with the change in female labour force participation during WW2. These findings support the assumption that the changes in female labour force participation during WW2 are not related to economic development or spending on primary and secondary education.

Data and Methodology

In order to estimate the effect of ECEC spending on later educational outcomes, we estimate the following model with 2SLS:

$$\mathrm{ECEC_j} = \alpha_0 + \alpha_1 \mathrm{LFP\Delta WW2_j} + \alpha_2 \mathrm{LFPpreWW2_j} + \mathrm{X'_{isj}}\lambda + \mathrm{S'_{sj}}\rho + \mathrm{Z'_j}\gamma + \mathrm{e_{isj}} \quad (1)$$

$$\mathrm{PISA_{isj}} = \beta_0 + \beta_1 \mathrm{ECEC_j} + \beta_2 \mathrm{LFPpreWW2_j} + \mathrm{X'_{isjt}}\lambda + \mathrm{S'_{sj}}\rho + \mathrm{Z'_j}\gamma + \mathrm{e_{isj}} \quad (2)$$

where equation (1) represents the first-stage, estimating the public spending on childcare and preschool $\mathrm{ECEC_j}$ in country j. $\mathrm{LFP\Delta WW2_j}$ is based on the change in female employment rates around WW2 (see below for a more extensive discussion). The regressions control for pre-WW2 differences in employment rates $\mathrm{LFPpreWW2_j}$ as well as student level $\mathrm{X_{isj}}$, school level $\mathrm{S_{sj}}$ and country level $\mathrm{Z_j}$ variables.

Our primary data is the 2012 wave of the Programme for International Student Assessment (PISA). PISA provides information on students' reading, mathematics achievements at age 15, their socioeconomic characteristics and the characteristics of the school they are attending. The 2012 wave of PISA includes achievement scores of students from 65 countries. However, our analysis focuses on Europe, US, Canada, Australia, New Zealand and Japan. As for some countries data on ECEC and/or data for our instrument is unavailable, in total we include 22 countries (17 European) in the analyses. Students are provided a fraction of all available questions in achievement tests. As in other large scale assessment surveys, plausible values are calculated by the OECD based on the responses to the particular questions that a student is given (Rutkowski et al., 2010). For reading and math scores of individuals, we use the mean of the five plausible values that are provided in the PISA dataset.

We capture variation in public spending on childcare and preschool ($\mathrm{ECEC_j}$) using data from OECD Statistics. As a part of the social expenditures data, OECD Statistics provides information on per capita public spending on early childhood education and care. We match students in PISA to the public spending on ECEC in their country when they were two years old. In practice, this means that most of the PISA 2012 (birth cohort 1996) sample is matched to public spending on ECEC in 1998.

However, a smaller percentage is younger and is therefore matched to the 1999 spending. We tested to what extent our results are robust to different measures of $ECEC_j$: for instance, spending levels at age 3, average spending during age 1-3 or public spending per 0-4 year old child instead of per capita could be used (see next section). Theoretically, we could capture between country differences in ECEC policies using child care coverage rates. However, this data is available for most countries from 2004-2005 onwards; for the period relevant for PISA 2012 (i.e. around 1998), coverage data is available for just 7 countries. Although our ECEC measure is likely to capture both quality and coverage dimensions, we can test how ECEC spending is related to coverage given that since 2005 the data on both spending and coverage is available: public spending is significantly correlated to coverage: see Figure 1A and 1B. The relation between spending and coverage is especially strong for the younger (0-2) age group (depending on the specific year, the correlation is 0,75-0,8, $p<0.0001$). The correlation with the coverage rate of older (3-5) children is significant but weaker (around 0,45-0,5). A potential explanation is that there is simply less between-county variation in childcare coverage for the older group (most countries have a coverage rate above 80 percent).

Figure 1A

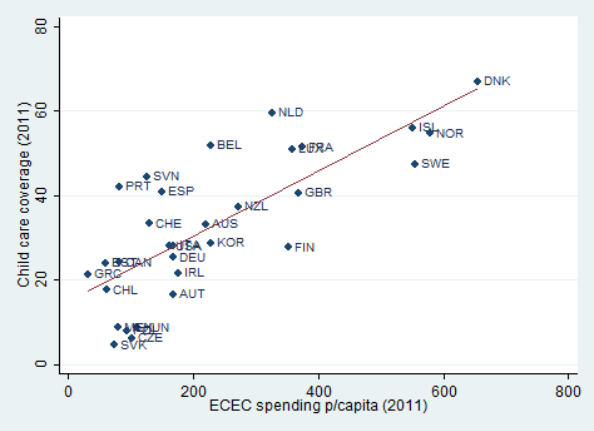
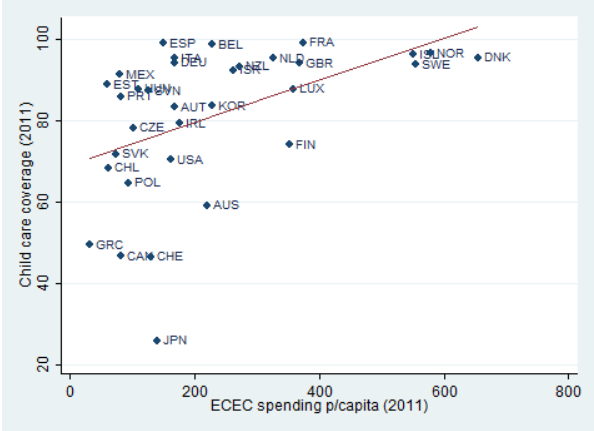
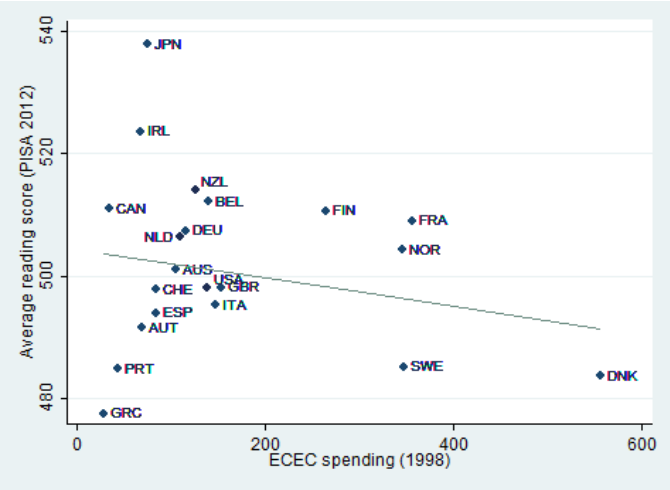


Figure 1B



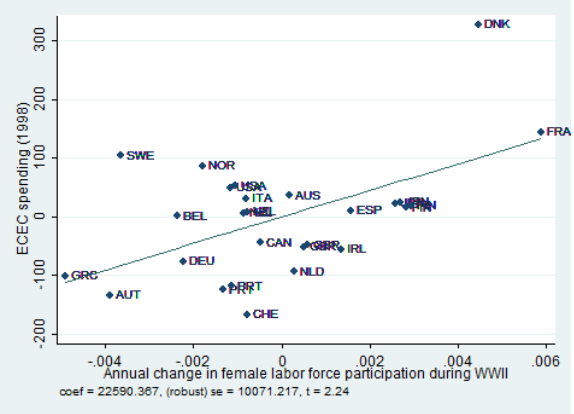
Interestingly, Figure 2 shows that there is no clear relationship between ECEC spending in 1998 and average reading scores of countries in PISA 2012. Highest spenders do not necessarily have higher scores. In fact, Sweden and Denmark which have the highest ECEC spending values appear to perform well below the cross-country average in PISA.

Figure 2



Our estimation strategy exploits the 'shock' in female labour force participation due to WW2 to predict between-country variation in ECEC spending. We use historical data from the International Historical Statistics (IHS) (Mitchell, 2007a; 2007b; 2007c) to construct our instrument. IHS contains data on the number of women economically active women by industry as well as data on population by age groups. To calculate the labour force participation rate, we aggregate the numbers of women economically active women for all industries and divide this by the total population aged 15 and older. Olivetti (2013) applies the same strategy and provides the data for several countries and relevant years: the labour force participation rates we calculated are generally consistent with those reported by Olivetti. To calculate the 'shock' in female participation rates we used the difference in female participation rates before 1940 and after 1945. In general, we use data before the start of the war, i.e. before 1940. An exception is Portugal, where we used the 1940 data as there appears to be an unexplained jump in the data before 1940 (as a neutral country, we expect this not to matter significantly). Since the data is not available for every year around the time of the war, the time gap between the first data point before and the first data point after the war varies from one country to another. To correct for this, we divide the difference in female participation rates by the total time difference in years. Finally, note that we excluded several countries as our instrument is not available or reliable for those: Poland experienced major territorial (and population) shifts during the war, Czechoslovakia currently consists of two separate countries and some present-day countries did not exist before WW2 (e.g. several Eastern Member States).

Figure 3



As the war has lead to millions of casualties, damaged cities, destroyed infrastructure and disrupted economic activities, it is likely that the war had a direct impact on economic development. Moreover, our instrument may be related to the current female participation rate. We take this into account by controlling for GDP per capita (2012), pre-WW2 female participation rate , female participation rate at age 2 (1998) and cumulative expenditure on primary and secondary education up to age 15. Conditional on these controls, our instrument significantly predicts between variation in ECEC spending: see Figure 3. In fact, the F-test statistic of the first-stage of our IV model is around 21, indicating that the female labour force participation shock during WW2 is a strong instrument for ECEC spending.

Results

Main findings

As a benchmark, Table 1 reports the OLS results on the relation between ECEC spending and PISA test scores. These results indicate that the level of public spending is negatively, rather than positively correlated to PISA scores. The results for the mathematics score are significant. Of course, these relations should be interpreted with caution, as the level of ECEC spending is endogeneous. The estimation results on the effects of ECEC based on our preferred specification, using the shock in female labour force participation during WW2 as an instrument, are substantially different: the coefficients are positive on both domains and significant ($p<0.10$) for the reading scores. The effect appears to be sizeable. If a country with one of the lowest level of ECEC spending (Greece: 28) would move to the level of the country that spends the most per capita on ECEC (Denmark: 556), language test scores would increase by around 32 points. This is a large effect: for instance, the coefficient of age (in years) is 17. However, moving from the lowest to highest spending country is an extreme and highly unlikely scenario. Most countries spend below 160 per capita: an increase of 50 to 100 seems

more probable: this would increase language test scores by 3 to 6 points, which corresponds to about 1/6 to 1/3 of the age effect.

Heterogeneous effects

We examined to what extent effects are concentrated within specific subgroups of the population. First, the main positive effect of ECEC seems to be concentrated within boys; test scores of girls do not seem to be affected by variation in ECEC spending. Second, to test distributional effects we tested whether ECEC affected the chances of being a low or high achiever. We use the PISA cutoff points and follow the standard definition of 'low achiever' (below level 2) and 'high achiever' (one of the 2 highest levels). These findings could be especially interesting from a policy perspective, as one of the EU 2020 benchmark for education is a maximum low achiever rate of 15 percent. In the model predicting whether the student is a low achiever, the coefficients are negative in both the reading and mathematics domain (indicating positive effects). However, the coefficients of the model predicting the likelihood of being a high achiever are positive and significant for both genders. Again, the ECEC effect is only significant in the reading domain. Furthermore, it appears that the gains are concentrated within higher SES groups (measured by the level of education of the mother). These findings seem to be inconsistent with the 'levelling the playing field' hypothesis. However, it should be noted that we do not estimate the effect of ECEC attendance. A potential explain for our findings is that mainly higher educated, dual earner families use these services and therefore the any potential benefits in terms of access and quality accrue to this group.

Table 1 – Main Results

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	IV	IV	IV
	Reading	Math	1st stage	Reading	Math
ECEC spending p/cap	-0.00270	-0.0584*		0.0608*	0.0276
	(0.0180)	(0.0318)		(0.0339)	(0.0615)
WW2 ΔFemale LFP			22,480***		
			(4,913)		
Female	24.49***	-17.20***	1.147*	24.37***	-17.36***
	(2.052)	(1.516)	(0.555)	(1.981)	(1.509)
Age (years)	16.69***	22.30***	-10.99**	17.02***	22.75***
	(1.562)	(3.108)	(4.116)	(1.508)	(3.451)
School starting age	-8.509***	-7.936***	5.307	-8.458***	-7.867***
	(1.429)	(1.727)	(7.622)	(1.370)	(1.593)
Siblings (Y/N)	-8.350***	-7.037***	-1.314	-8.412***	-7.121***
	(1.548)	(1.693)	(1.228)	(1.503)	(1.632)
Single parent household	-6.253***	-8.435***	1.533	-6.481***	-8.744***
	(1.205)	(1.007)	(1.791)	(1.233)	(1.123)
Other household type	-27.30***	-29.59***	1.025	-27.53***	-29.91***
	(2.545)	(2.825)	(2.517)	(2.560)	(2.875)
Father employed	-1.544	1.381	-1.408	-1.357	1.634
	(2.633)	(2.324)	(2.137)	(2.648)	(2.373)
Mother employed	-0.699	1.763	-0.823	-0.900	1.490
	(2.605)	(1.817)	(1.735)	(2.487)	(1.703)
Educational level mother: medium	2.946	4.956***	1.806	2.336	4.130**
	(2.535)	(1.630)	(3.429)	(2.357)	(1.631)
Educational level mother: high	4.657	5.650	6.561	3.459	4.026
	(3.652)	(3.721)	(5.079)	(3.444)	(3.727)
Educational level father: medium	8.174***	6.373***	0.447	7.988***	6.121***
	(2.356)	(1.891)	(2.069)	(2.399)	(1.956)
Educational level father: high	14.93***	17.08***	-4.454	15.13***	17.34***
	(3.778)	(3.419)	(2.831)	(3.725)	(3.394)
Occupation status parents (index)	0.697***	0.723***	0.105*	0.691***	0.715***
	(0.0431)	(0.0548)	(0.0561)	(0.0442)	(0.0569)
Immigrant	9.342	4.644	4.451	8.577	3.607
	(8.135)	(8.429)	(4.524)	(8.260)	(8.646)
Other language spoken at home	-8.633***	-6.426	0.709	-8.387***	-6.093
	(2.399)	(3.954)	(1.951)	(2.375)	(4.006)
Books present in household (scale 1-4)	23.31***	23.70***	-0.843	23.47***	23.92***
	(1.225)	(1.299)	(1.028)	(1.234)	(1.322)
Female LFP (pre-WWII)	83.58***	123.0***	352.1***	69.19***	103.5***
	(14.14)	(20.44)	(105.7)	(13.84)	(23.11)
Female LFP (age 2)	-0.312***	-0.201	-1.219	-0.255**	-0.123
	(0.0871)	(0.170)	(0.776)	(0.116)	(0.189)
Current GDP	0.000511*	0.000632	0.00595***	0.000232	0.000255
	(0.000268)	(0.000462)	(0.00183)	(0.000375)	(0.000543)
Educational expenditure per student	-0.000174	-0.000254	0.00146	-0.000276	-0.000393
	(0.000195)	(0.000206)	(0.000929)	(0.000226)	(0.000261)
Country: non-Europe	10.43**	1.231	-149.0***	16.83***	9.910

	(4.010)	(5.605)	(26.14)	(4.673)	(7.195)
Location: Small town	3.053	2.109	-13.05	4.026	3.429
	(3.113)	(3.028)	(9.829)	(3.276)	(3.429)
Location: Town	13.81***	11.12***	-7.725	14.64***	12.25***
	(2.561)	(2.125)	(8.798)	(2.841)	(2.658)
Location: City	17.69***	11.79**	-13.66	18.85***	13.37**
	(3.376)	(4.816)	(10.36)	(3.892)	(5.615)
Location: Large city	22.72***	18.62***	-9.446	23.73***	19.99***
	(4.002)	(4.665)	(8.715)	(4.327)	(5.177)
Public school	-1.664	-2.558	14.54*	-1.782	-2.716
	(3.790)	(5.196)	(7.535)	(3.858)	(5.288)
Student teacher ratio	0.401	0.393	-0.184	0.411	0.406
	(0.283)	(0.282)	(0.240)	(0.284)	(0.286)
School quality (index)	5.587***	4.118***	-0.570	5.488***	3.983***
	(1.501)	(0.883)	(1.254)	(1.492)	(0.881)
Constant	137.8***	52.11	-78.80	143.0***	59.11
	(32.83)	(48.72)	(118.5)	(32.05)	(51.77)
Observations	133,749	133,749	133,749	133,749	133,749
R-squared	0.253	0.255	0.671	0.251	0.251
Nr of countries	22	22	22	22	22

Clustered (at country level) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: IV Results by Gender

	Boys		Girls	
	(1)	(2)	(3)	(4)
	Reading	Math	Reading	Math
ECEC spending p/c	0.0772*	0.0227	0.0434	0.0322
	(0.0411)	(0.0626)	(0.0280)	(0.0604)
Observations	65,695	65,695	68,054	68,054
R-squared	0.220	0.241	0.253	0.252
Nr of countries	22	22	22	22

Clustered (at country level) standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: IV Results - low and high achievers

		Low achiever		High achiever	
		(1)	(2)	(3)	(4)
		Reading	Math	Reading	Math
All	ECEC spending p/c	-5.84e-05	-0.000174	0.000221**	1.56e-05
		(7.17e-05)	(0.000165)	(8.68e-05)	(0.000167)
Boys	ECEC spending p/c	-0.000113	-0.000112	0.000194**	1.34e-05
		(0.000108)	(0.000157)	(8.09e-05)	(0.000181)
Girls	ECEC spending p/c	2.87e-06	-0.000231	0.000246***	1.36e-05
		(4.50e-05)	(0.000175)	(9.35e-05)	(0.000153)

Clustered (at country level) standard errors in parentheses. Results are based on 133,749 (All), 65,695 (Boys) and 68,054 observations using data from 22 countries.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: IV Results – Effects by mother's education level

Education level mother:		Low		Medium		High	
		(1)	(2)	(3)	(4)	(5)	(6)
		Reading	Math	Reading	Math	Reading	Math
All	ECEC spending p/c	-0.00940	-0.0456	0.0112	-0.0131	0.119**	0.0817
		(0.0230)	(0.0494)	(0.0354)	(0.0547)	(0.0473)	(0.0741)
		23,149	23,149	49,470	49,470	61,130	61,130
Boys	ECEC spending p/c	0.0270	-0.0186	0.00586	-0.0461	0.140***	0.0869
		(0.0365)	(0.0613)	(0.0394)	(0.0556)	(0.0539)	(0.0738)
		10,959	10,959	24,397	24,397	30,339	30,339
Girls	ECEC spending p/c	-0.0401	-0.0610	0.0154	0.0163	0.0980**	0.0784
		(0.0303)	(0.0464)	(0.0317)	(0.0547)	(0.0417)	(0.0759)
		12,190	12,190	25,073	25,073	30,791	30,791

Clustered (at country level) standard errors in parentheses. Results are based on data from 22 countries.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 - IV Results for Europe

	Europe		Europe (w/o Hungary)	
	(1)	(2)	(3)	(4)
	Reading	Math	Reading	Math
ECEC spending p/c	0.0467***	0.00255	0.0486***	0.00409
	(0.0129)	(0.0260)	(0.0142)	(0.0255)
F-test (Instrument)	37.6	37.6	37.9	37.9
Observations	101,402	101,402	97,837	97,837
R-squared	0.293	0.275	0.289	0.272
Nr of countries	17	17	16	16

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Conclusion

To be completed

References

Black, S. E., Devereux, P. J., Løken, K. V., & Salvanes, K. G. (2014). Care or cash? The effect of child care subsidies on student performance. *Review of Economics and Statistics*, *96*(5), 824-837.

Cunha, F., & Heckman J., (2007). The technology of skill formation. NBER Working Paper No. 12840.

Duncan, G.J., & Magnuson, K. (2013). Investing in preschool programs. Journal of Economic Perspectives, 27, 109-131.

Elango, S., García, J. L., Heckman, J. J., & Hojman, A. (2015). Early Childhood Education. NBER Working Paper No. 2176.

Felfe, C., Nollenberger, N., & Rodríguez-Planas, N. (2015). Can't buy mommy's love? universal childcare and children's long-term cognitive development. *Journal of population economics*, *28*(2), 393-422.

Hacker, J. S. (2004). Privatizing risk without privatizing the welfare state: The hidden politics of social policy retrenchment in the United States. *American Political Science Review*, *98*(02), 243-260.

Hanushek, E. A. (2006). Does Educational Tracking Affect Performance and Inequality? Differences-in-Differences Evidence Across Countries*. *The Economic Journal*, *116*(510), C63-C76.

Hanushek, E. A. (2011). The economic value of higher teacher quality. *Economics of Education Review*, *30*(3), 466-479.

Hanushek, E. A., & Woessmann, L. (2010). *The economics of international differences in educational achievement* (No. w15949). National Bureau of Economic Research.

Hanushek, E. A., Link, S., & Woessmann, L. (2013). Does school autonomy make sense everywhere? Panel estimates from PISA. *Journal of Development Economics*, *104*, 212-232.

Hanushek, E. A., Schwerdt, G., Wiederhold, S., & Woessmann, L. (2015). Returns to Skills around the World: Evidence from PIAAC. *European Economic Review*, *73*, 103-130.

Havnes, T., & Mogstad, M. (2011). No child left behind: Subsidized child care and children's long-run outcomes. *American Economic Journal: Economic Policy*, 97-129.

Heckman, J. J. (2006). Skill formation and the economics of investing in disadvantaged children. *Science*, *312*(5782), 1900-1902.

Heckman, J.J., & Masterov, D.V. (2007). The productivity argument for investing in young children. NBER Working Paper No. 13016.

Kamerman, S. B. (2007). A global history of early childhood education and care. *background paper prepared for the Education for All Global Monitoring Report*.

Lounkaew, K. (2013). Explaining urban–rural differences in educational achievement in Thailand: Evidence from PISA literacy data. *Economics of Education Review, 37*, 213-225.

Melhuish, E., Ereky-Stevens, Petrogiannis, K., Ariescu, A., Penderi, E., Rentzou, K., Tawell, A., Leseman, P. & Broekhuisen, P. (2015). A review of research on the effects of early childhood education and care (ECEC) on child development, CARE publication.

Mitchell, B.R. (2007a). International Historical Statistics; Africa, Asia & Oceania 1750-2005. 6th edition, Macmillan.

Mitchell, B.R. (2007b). International Historical Statistics; Europe 1750-2005. 6th edition, Macmillan.

Mitchell, B.R. (2007c). International Historical Statistics; The Americas 1750-2005. 6th edition, Macmillan.