Institute for Economic Studies, Keio University

Keio-IES Discussion Paper Series

家計所得が子どもの教育成果と教育費支出に与える因果的効果：我が国の児童手当改革を用いた検証

直井道生、赤林英夫、中村亮介、野崎華世、佐野晋平、妹尾渉、敷島千鶴

2017 年 11 月 13 日
DP2017-026
https://ies.keio.ac.jp/publications/8579/

Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp
13 November, 2017

家計所得が子どもの教育成果と教育費支出に与える因果的効果：
我が国の児童手当改革を用いた検証

直井道生、赤林英夫、中村亮介、野崎華世、佐野晋平、妹尾渉、敷島千鶴

IES Keio DP2017-026
2017 年 11 月 13 日
JEL Classification: H24; H31; I21; I28; I38
キーワード: 児童手当; 家計所得; 教育費支出; 学力

【要旨】

本稿は、日本子どもパネル調査(JCPS)を用い、家計所得が子どもの学力と教育費支出に与える因果的効果を検証した。2010年から2012年かけて起こった児童手当（子ども手当を含む）制度の変化により引き起こされた手当額の増減を家計所得に対する外生的な変動とみなし、その変動を利用して家計所得が子どもの学力や教育費支出に対して影響を与えているかを検証した。最小二乗法（OLS）や階差モデル（FD）の推計によると、家計所得と子どもの学力、教育費支出は正の相関を持つことが確認された。しかし、家計にとって外生的な制度変更に伴う受取児童手当額の変化を操作変数として用いた固定効果操作変数法（FDIV）の推計によると、家計所得は学力に統計的に有意な影響を与えていないことから、OLSやFDで観察された結果は因果的効果を示していないことが示唆された。ただし、FDIVの下でも、家計所得は教育費支出に正の影響を与えていることが示された。サンプルをサブグループ（両親の学歴、所得水準、子どもの年齢、子どもの性別）に分けて分析を行ったところ、高所得グループと女児に関しては、家計所得は教育費支出に正の影響を与えていることが示されたものの、それ以外に関しては関係が観察されなかった。

直井道生
慶應義塾大学経済学部
〒108-8345
東京都港区三田2-15-45
naoi@econ.keio.ac.jp

赤林英夫
慶應義塾大学経済学部
〒108-8345
東京都港区三田2-15-45
hakab@econ.keio.ac.jp

中村亮介
福岡大学経済学部
〒814-0180
福岡県福岡市城南区七隈八丁目19-1
ryonaka.email@gmail.com

野崎華世
高知大学人文社会科学部
〒780-8520
高知県高知市曙町2-5-1
kayo1130@gmail.com

佐野晋平
千葉大学法政経学部
〒263-8522
千葉県千葉市稲毛区弥生町1-33
shimpei_sano@chiba-u.jp

妹尾渉
国立教育政策研究所教育政策・評価研究部
〒100-8951
東京都千代田区霞が関3-2-2
senoh@nier.go.jp

敷島千鶴
帝京大学文学部
〒192-0395
東京都八王子市大塚359
shiki@main.teikyo-u.ac.jp

謝辞：本研究を進めるに際し、Yu Xie 氏、James Raymo 氏、Cheng Hsiao 氏、北条雅一氏、菊池信義氏、吉田友紀氏、CMES2017(Wuhan)、SLLS2016(Bamberg)、RIETI、2016 日本経済学会（早稲田大学）、第 19 回労働経済コンフェレンス（大阪大学）、日本経済政策学会西日本部会（鹿児島国際大学）での発表の際の参加者から多くの貴重なコメントをいただきました。また、土居丈朗氏からは可処分所得計算のためのプログラムを快くご提供いただきました。また、山口一大氏にはIRT スコアの計算に際して多大なご支援をいただきました。本稿の分析に際しては、慶應義塾大学パネルデータ設計・解析センターによる「日本家計パネル調査(JHPS/KHPS)」「日本子どもパネル調査(JCSP)」の個票データの提供を受けました。心から感謝を致します。

Causal Effects of Family Income on Child Outcomes and Educational Spending: Evidence from a Child Allowance Policy Reform in Japan*

Michio Naoi (Keio University)†, Hideo Akabayashi (Keio University), Ryosuke Nakamura (Fukuoka University), Kayo Nozaki (Kochi University), Shinpei Sano (Chiba University), Wataru Senoh (National Institute for Educational Policy Research), Chizuru Shikishima (Teikyo University)

Abstract

We examine the causal effects of family income on child outcomes and households' educational spending using panel data of children matched to their parents. Our identification strategy relies on the largely exogenous, discontinuous changes in the Child Allowance Policy in Japan that occurred between 2010 and 2012. We examine whether an exogenous variation in family income due to policy changes in the payment schedule has any causal effects on children's cognitive outcomes and households' educational spending. Our ordinary least squares (OLS) and first-differenced (FD) results show that, in most cases, family income is positively correlated with children's cognitive outcomes and family's educational investment. Our FD instrumental variable (FD-IV) results, using exogenous changes in child allowance payments as an instrument, show that family income does not have any causal impacts on child outcomes in the short run. This suggests that the positive income effects on cognitive outcomes in OLS and FD models are not causal effects. In comparison, we find some evidence of positive income effects on households' educational spending. To examine the heterogeneous effects, we estimate FD-IV regressions for various population subgroups: those divided by parental education, income levels, children's age, and gender. We find that family income does not have statistically significant impacts on children's cognitive ability, whereas it has significant positive impacts on educational spending for high-income families and girls.

Keywords: Child allowance; family income; educational spending; cognitive outcome

JEL Classifications: H24, H31, I21, I28, I38

---

* We would like to thank Yu Xie, James Raymo, Cheng Hsiao, Masakazu Hojo, Nobuyoshi Kikuchi, Yuki Yoshida, and participants in seminars at CMES2017 (Wuhan), SLLS2016 (Bamberg), RIETI, 2016 Japanese Economic Association Autumn Meeting (Waseda University), 19th Labor Economics Conference (Osaka University), and JEPA Nishinihon Branch (International University of Kagoshima). We also thank Takero Doi for furnishing the program of calculating disposal income, and Kazuhiro Yamaguchi for calculating IRT scores. We are grateful to the Panel Data Research Center at Keio University for the individual data drawn from the Japan Household Panel Survey (JHPS/KHPS) and Japan Child Panel Survey (JCPS). This work was supported by JSPS KAKENHI Grant Numbers JP16H06323, 17H06086, and 24000003.

† Corresponding author. Faculty of Economics, Keio University. *Address*: 2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan. *Email*: naoi@econ.keio.ac.jp.

1. Introduction

What determines the outcomes of children? This question has a long history among social scientists, at least since the publication of the Coleman Report (Coleman et al., 1966), which found that, as a whole, family background variables tend to explain a larger part of the variations in children's achievement than school resource variables do. Since then, much research effort has been devoted to determining factors both at school and for the family that most influence the outcomes of children.

One variable that has been the major focus of economic research is household income. The simplest human capital theory predicts that under the complete market assumption, the amount of educational investment does not depend on the household's income level (Becker, 1962). Therefore, any difference in outcomes should be the result of child characteristics, such as genetic ability. Becker also proposed a theory in which an interaction between financial market imperfection and children's characteristics generates a variation in educational investment and outcomes (Becker, 1967). Many researchers have questioned the assumption of the complete market and examined whether households with low income face financial/borrowing constraints and thereby have difficulty investing in their children's human capital, typically focusing on children's college enrollment (Carneiro and Heckman, 2002; Keane, 2002; Cameron and Taber, 2004; Belley and Lochner, 2007).

Understanding the mechanisms by which family income affects educational investment and child outcomes would certainly have important policy implications. If, for example, poor families invest less in their children's education than wealthier families, due primarily to the lack of borrowing opportunities, government intervention can be justified on both efficiency and equity grounds. Policymakers might then use programs that redistribute resources to low-income families or directly invest in children via secure public education or other forms of in-kind subsidies.

Furthermore, many public programs that directly invest in children would involve both a substitution and an income effect. Identifying the causal impact of family income on educational investment and child outcomes would therefore be important for the optimal design of various public programs (Blau, 1999). If the income elasticity of investment in children is large enough, cash transfers would be a more efficient way to encourage investment in children than direct provision of cheaper investment opportunities.

The major challenge in attempting to identify the causal impact of family income on child outcomes would be the endogeneity of income. Family income is generally correlated with parental educational achievement, which is likely to be correlated with parents and children's unobserved abilities (Duncan and Brooks-Gunn, 1997; Mayer, 1997). Furthermore, some important factors contributing to child outcomes, such as home environment, parenting practices, and cultural backgrounds, are not always observable to researchers. These factors tend to correlate with family income, but they might be stable over time even when family income varies substantially. Failing to control for these unobserved factors, which are correlated with both family income and children's achievement, would result in bias in the estimation of the effect of family income.

Researchers have sought ways to disentangle the effects of unobservable factors and family income by using a number of methods. Some authors used child fixed effects to identify the effect of transitory income on child outcomes (Duncan et al., 1998; Blau, 1999). Recently, a more prominent approach is to find an exogenous variation of family income that is uncorrelated with unobservable factors. For example, Løken (2010) used the economic boom of the 1970s and 1980s—caused by the discovery of oil fields in Norway—as an IV for increase in income and found no effect on children's outcomes. Akee et al. (2010) used the opening of a casino in North Carolina that benefitted a subpopulation in the area (Native American tribes) and found that it raised children's educational achievement and lowered their probability of committing crimes. Changes in tax and welfare policies have also been used as exogenous sources of variation in income. For example, Dahl and Lochner (2012) used changes in the Earned Income Tax Credit (EITC) in the United States and showed that increased earnings because of the policy change improved the test scores of children in families subject to this policy change.

In this study, we use changes in the Child Allowance Policy (CAP) in Japan that occurred in the early 2010s to examine the causal effects of family income on child outcomes (cognitive test scores) and households' private educational spending. Our identification strategy relies on the largely exogenous, discontinuous changes in the CAP in Japan that took place between 2010 and 2012. Prior to FY2010, a child aged 12 or younger was eligible for the allowance. A monthly allowance was determined based on children's age and birth order. In FY2010, the government substantially expanded the amount and scope of the allowance. A child aged 15 or younger became eligible for the allowance, which was 13,000 JPY per month, independent of the child's age. The current policy, from FY2012, provides a monthly allowance again based on children's age and birth order.

The policy changes described above provide an ideal situation for identifying the income effects on child outcomes for several reasons. First, policy changes were most likely unanticipated by families since they were a result of regime change (from the Liberal Democratic Party of Japan to the Democratic Party of Japan) after the national election. Second, a monthly allowance payment is solely determined based on the number and age of existing children in the family, which cannot be controlled by individual households. In other redistribution policies, such as the EITC in the United States, families can endogenously change their behavior to manipulate the benefits or subsidies they receive from the policy. Altogether, we believe that changes in the CAP can provide an exogenous source of variation in income.

Several previous studies in Japan examined the effect of the CAP on consumption patterns (Kobayashi, 2011; Unayama, 2011), mental health of parents (Takaku, 2015), and household wealth accumulation (Stephens and Unayama, 2015). To our knowledge, however, no previous research has examined its effect on households' educational expenditure and direct measures of children's educational outcomes, which are primary targets of the policy.

Our empirical findings suggest that, while we observe a significantly positive correlation between family income and children's cognitive outcomes as well as family's educational investment, these relationships are not necessarily a causal effect of family income under our identifying assumption. When using exogenous changes in child allowance payments as an instrument, an increase in family income does not have statistically insignificant impacts on child outcomes, whereas it significantly raises households' educational spending.

The remainder of the paper is organized as follows. Section 2 summarizes the institutional background of the CAP in Japan. Section 3 provides a brief description of the dataset used in our empirical analysis. Section 4 sets out our identification strategy based on exogenous variation in family income due to policy changes, and provides the empirical specification. Section 5 presents our empirical results followed by discussions and concluding remarks in Section 6.

2. Background: The Child Allowance Policy in Japan

The CAP, or child benefit programs in general, is a form of direct cash transfer to families with dependent children. In most countries, child benefits are means tested, and the amount paid is usually determined based on the number and age of children in the family.

In Japan, the CAP was introduced in 1972, and the government has gradually expanded the amount and scope of allowance since then. Table 1 provides a brief description of the CAP at several points in time since 1992, which is relevant for the families in our dataset.[1] In 1992, the policy covered children up to the age of three, and the parent would receive 5,000 JPY a month for each first/second child and an additional 5,000 JPY for the third or subsequent child. As shown in the table, the age limit for eligible children was gradually extended throughout the 2000s, but the amount paid long remained at its 1992 level until 2010.[2]

(Table 1 around here)

---

[1] The oldest cohort of children in our dataset was born in April 1994.

[2] In 2007, the monthly allowance was set at 10,000 JPY for children younger than three years, regardless of their birth order.

In 2010, the Democratic Party of Japan (DPJ), the then ruling party of Japan, substantially expanded the amount and scope of the allowance. A child aged between 13 to 15 years additionally became eligible for the allowance, and the income test was abolished. The parent would receive 13,000 JPY per month for each child regardless of the child's age or birth order.

The DPJ initially planned to double the payments to 26,000 JPY from April 2011. However, due to revenue shortages, the DPJ gave up this plan and reintroduced the age bracket-based allowance in October 2011. The parent would receive 15,000 JPY a month for each child younger than three years. For a child of three years or older, the allowance paid varied depending on birth order. For each first/second child, the parent would receive 10,000 JPY a month (if the child was of 3–15 years). The parent would receive an additional 5,000 JPY a month for the subsequent child. The payments remained fixed in the current system, but income tests to determine eligibility for the child allowance were reintroduced in 2012.

These changes in the CAP are likely to provide an exogenous source of income variation that we use to identify the effect of family income on child outcomes. Figure 1 shows the amount of child allowance by children's birth cohort before and after the recent policy changes. Panel A of Figure 1 shows the payment schedules before and after the policy change in 2010. For example, children born in April 1995, who became 15 years old in April 2010, would not receive any child allowance under the 2009 system since they were not eligible for a child allowance (dashed line). In comparison, under the 2010 system, after expansion in the scope of the allowance in 2010, they were eligible for an allowance and received 117,000 JPY (a monthly payment of 13,000 JPY for nine months between April and December 2010; solid line).[3] On the other hand, children born in March 1995 were not eligible for child allowance in neither the 2009 nor the 2010 system since the eligibility for child allowance is determined based not on the calendar year but fiscal year.

(Figure 1 around here)

Other birth cohorts had experienced both expansion and reduction of child allowance. For example, children born in April 2000, who became 10 years old in April 2010, would have received 60,000 JPY annually under the 2009 system (5,000 JPY for 12 months). In comparison, under the 2010 system, they experienced the expansion of child allowance and received 132,000 JPY (a monthly payment of 5,000 JPY for the first three months and 13,000 JPY for the rest of the year; Panel A). This was followed by the reduction in child allowance caused by the policy change in 2011. Panel B of Figure 1 shows the payment schedules before and after the policy change in 2011. Under the 2010 system, they would have received 156,000 JPY (a monthly payment of 13,000 JPY for 12 months). In

[3] Note that the 2010 system was in effect in April 2010. As a result, they were not eligible for a child allowance for the first three months (between January and March 2010).

comparison, the actual payment under the 2011 system was 120,000 JPY (10,000 JPY for 12 months; Panel B).

In sum, recent changes in the CAP provide ideal exogenous variation in family income due to expansion in the eligible age limits and changes in monthly payments for children in a given birth cohort.[4] Since families cannot "manipulate" the number and age of existing children, these unanticipated policy changes provide purely exogenous variation in the receipt of the total amount of child allowance.

3. Data: The Japan Child Panel Survey

Our empirical analysis draws on the Japan Child Panel Survey (JCPS), a longitudinal parent-child survey initiated in 2010 at Keio University.[5] It was designed as a supplementary module to the Keio Household Panel Survey (KHPS) and Japan Household Panel Survey (JHPS), two comprehensive adult longitudinal surveys initiated in 2004 and 2009, respectively.[6]

The JCPS participants were parents with children in elementary school (aged 6–12 years) or junior high school (aged 12–15 years), as well as the children themselves. Parents in the JCPS were selected from the respondents of either KHPS or JHPS based on the children's age criteria. The survey was conducted in February of each year but the targeted respondents (i.e., KHPS or JHPS respondents) were switched each year. As a result, each JCPS respondent participated in the survey every two years.[7] Figure 2 summarizes the JCPS, JHPS, and KHPS timeline structure.

(Figure 2 around here)

---

4 Another source of variation in child allowance comes from changes in the income cap. For example, families wherein the main earner's income was above the threshold of 8.6 million JPY were not eligible for child allowance in 2009. Abolishment of this income cap in 2010 resulted in discontinuous increase in child allowance payments for some high-income families. However, in the following analysis, we decided not to use this discontinuity for two reasons. First, households might adjust their income levels in response to the income cap. As a result, discontinuous changes in child allowance due to income caps are not necessarily exogenous. Second, some local governments provide their own child benefits for families with income above the CAP limit, which are not fully observable in our dataset.

5 Further details about the survey can be found in Shikishima (2013) and Akabayashi et al. (2016), and the references therein.

6 The JCPS structure is similar to that of the Children of National Longitudinal Survey of Youth.

7 An exception was the latest JCPS survey in 2014, which involved participants from both the KHPS and JHPS. As a result, KHPS respondents were interviewed in two consecutive years—2013 and 2014—which is different from prior waves, wherein they were interviewed on an alternate-year basis.

The JCPS questionnaire consists of children and parents' forms. The children's form includes self-conducted, basic academic ability tests on Japanese language and arithmetic/mathematics, as well as a questionnaire relating to school, studies, and the subjective quality of life. The parents' questionnaire includes items such as the time the child spent studying, actual household expenditure on education in a typical month in the previous year, and the child's socialization and problem behaviors. Parents who had two or more children were asked to respond to an individual questionnaire for each child.

We construct measures of children's cognitive ability from academic ability test scores for Japanese language (hereto referred to as Japanese) and arithmetic/mathematics (hereto referred to as mathematics).[8] The Japanese questions consisted of vocabulary as well as reading and writing of *kanji* characters. The mathematics questions consisted of calculations and word problems concerning numbers and manipulation of figures (for details of the academic ability test, see Shikishima et al., 2013). Although different sets of questions were prepared for each grade in line with the government's course guidelines, all Japanese and mathematics question items were equated based on the item response theory (IRT).[9] With this technique, we estimated each child's latent Japanese and mathematics ability, which can be directly comparable across grades.[10] In the following analysis, we used these IRT-based estimated scores as each child's underlying Japanese and mathematics ability.

Since family income can affect decisions about investment in children, we also use measures of educational investment in our empirical analysis. The JCPS measures educational investment for each child made by the parent, including monetary expenditure in several categories (tuition, allowances, and extra-curricular study costs) and frequency of the child's extra-curricular activities (arts, sports, study excluding cram school, and cram school). In the following analysis, we use monthly expenditure for parents' educational investment.

Our income measure is the total disposable income constructed from the pre-tax family income and a set of family and individual characteristics available from the survey. The KHPS/JHPS provides the pre-tax family income for various components: wage and salary, business income, rental income, interest and dividends, pension income, and income from other sources. Following Doi (2010), tax amounts, deductions, and various transfers (including child allowance payments) are calculated based

---

[8] There are other important non-cognitive and health outcomes in our survey. These include, for example, measures of children's behavioral problems, quality of life, and children's height and weight at present and at birth.

[9] Item response models specify how an individual's latent trait level and an item's properties are related to how an examinee responds to that item, as well as to a set of items (Lord, 1980; Hambleton and Swaminathan, 1985).

[10] We employed a one-parameter IRT model that specifies the probability of a correct response as a logistic distribution in which items vary only in terms of their difficulty.

on the reported family structure and information about each household member. Using these results, we calculate the total disposable (i.e., post-tax and post-transfer) family income. In the following analysis, we exclude families whose income exceeds the CAP's eligibility limits at least once in our sample period.[11]

The amount of child allowance is calculated based on the age and birth order of each child in the family (see Table 1 for details). The child-level allowance payments are then aggregated at the household-level to calculate the total amount of allowance received by each household.

In addition to the outcome variables discussed above, the JCPS, together with the KHPS and JHPS, collects a rich set of characteristics for children and their households over time. In the following regression analysis, we always control for age (grade) and sex of children, number of siblings, father and mother's education, location of household, and survey years.

After eliminating observations with missing values for child outcome and explanatory variables, as well as households with family income above the CAP's eligibility limit, our sample consists of 1,943 observations with 1,185 unique parent-child pairs. Descriptive statistics are shown in Table 2.

(Table 2 around here)

4. Identification Strategy and Empirical Specification

In this section, we discuss our empirical specification for the analysis of income effects on child outcomes and educational investment.

A common specification used in the literature assumes that child outcomes depend on observable permanent and time-varying characteristics. In addition, the literature also suggests that time-invariant heterogeneity (such as innate ability) plays an important role in determining the outcomes. Assuming a linear specification, our benchmark model for child outcome s_{ia} becomes

$$s_{ia} = \mathbf{z}_i'\boldsymbol{\alpha}_a + \mathbf{x}_{ia}'\boldsymbol{\beta} + \delta_i + \varepsilon_{ia}, \quad (1)$$

where $\mathbf{x}_{ia}$ is a vector of time-varying characteristics of child i at age a, $\mathbf{z}_i$ is a vector of time-invariant observables (such as age, sex, and birth order of child i, including the constant), and δ_i is the time-invariant unobservable heterogeneity. This model is considered general as it allows the

[11] The reason for this sample restriction is discussed in Footnote 4. In addition, we also restrict our sample to nuclear/single-parent families. The calculation of disposable income requires us to identify all non-working dependents in the family. This is, however, rather complicated for extended families.

marginal effects of $\mathbf{z}_i$ to be different depending on the child's age.[12]

To eliminate the unobserved heterogeneity δ_i from Equation (1), one can take the first differences of Equation (1):

$$\Delta s_{ia} = \mathbf{z}_i'\boldsymbol{\alpha} + \Delta\mathbf{x}_{ia}'\boldsymbol{\beta} + \Delta\varepsilon_{ia}, \tag{2}$$

where, following Dahl and Lochner (2012), $\boldsymbol{\alpha} \equiv \boldsymbol{\alpha}_a - \boldsymbol{\alpha}_{a-1}$ is assumed to be constant across children's age.

Our primary interest is in identifying the causal impact of contemporaneous income (which is part of $\mathbf{x}_{ia}$). A major challenge in identifying the income effect based on Equation (2) is that, as discussed earlier, changes in income levels can be endogenous even after taking first differences. To cope with this issue, we exploit the exogenous income variation due to changes in child allowance payments.

As discussed in Section 2, child allowance payments are exogenously determined by the age and birth order of each child in the household.[13] Let $c_t(\mathbf{F}_{ia})$ give the actual amount of child allowance received by the family under the payment schedule in year t as a function of family structure $\mathbf{F}_{ia}$, which contains the age and birth order of all children in the household. Note that as the payment schedule has been changed during our sample period, the function can depend on the year in which benefits were calculated.

In the following analysis, we exploit exogenous variation in allowance payments due to policy changes and use it as an instrumental variable (IV) for family income. A natural candidate for the instrument is changes in the actual child allowance payments, $\Delta c_t \equiv c_t(\mathbf{F}_{ia}) - c_{t-1}(\mathbf{F}_{i,a-1})$, which exploit any variation in the allowance payments due to policy changes as well as discontinuity in the prespecified payment schedule. For example, if the number of children remains the same and all existing children fall into the same age brackets of payment schedule as in the previous period, then Δc_t would be zero if there are no policy changes. Even in this case, changes in the payment schedule can yield fluctuations in Δc_t, which captures payment variation due to policy changes. On the other hand, since the payments are discontinuously changed at the certain age threshold (e.g., payment for the first child

---

[12] A more general model might assume that time-varying characteristics have a long-lasting influence on child outcomes. Introducing past values of time-varying characteristics on the right-hand side of Equation (1) can accommodate the long-lasting influence of past time-varying characteristics. However, it is often difficult to estimate such a general model, particularly with a short panel. As a result, a common specification in the literature focuses only on the contemporaneous effects of $\mathbf{x}_{ia}$ and ignores any long-run effects.

[13] Except for the period between 2010 and 2011, the payments also depend on the main earner's pretax income since the CAP has an eligibility requirement based on income. However, as we omit observations with income above the eligibility limit, we ignore this feature here.

is reduced at the age of three), Δc_t can be non-zero even when the household faces the same payment schedule across adjacent periods.

To be more precise, changes in the actual child allowance payments can be rewritten as

$$\Delta c_t \equiv [c_t(\mathbf{F}_{ia}) - c_{t-1}(\mathbf{F}_{ia})] + \left[c_{t-1}(\mathbf{F}_{ia}) - c_{t-1}\left(\mathbf{F}_{i,a-1}\right)\right], \quad (3)$$

where the first bracket represents the payment variation due to policy change, and the latter represents variation due to changes in family structure (under the payment schedule in the previous period).

However, one might think that payment variation due to family structure can be correlated with short-term income changes. For example, mothers tend to start work again as their child gets older, which implies the correlation between changes in income and age of children in the household, and thus changes in child allowance payments. If this is the case, we should only exploit variation in allowance payments due to policy changes in payment schedules over time and not due to changes in family structure.

To address this issue, we use payment variation due only to policy change as our IV, which is the first bracketed term on the right-hand side of Equation (3). This represents the difference between the actual and counterfactual payments of child allowance. The counterfactual payments are calculated based on the payment schedule in the previous year given the family structure in year t.

In the following analysis, we use the total allowance payments at the household level, that is, sum of individual payments for each child in the household. When we calculate the counterfactual payments at the household level, we do not include individual payments for a newborn child (i.e., child born between year $t-1$ and t).

5. Effects of Exogenous Change in Income on Child Outcomes

As a preliminary step, we begin by presenting OLS and first-differenced (FD) estimates of the effects of family income on our cognitive outcomes and educational spending. Table 3 shows our empirical results. As for cognitive outcomes, we use the Japanese ability score, mathematics ability score, and combined score of the two subjects. Panel A presents OLS estimates for Equation (1), ignoring the presence of child fixed effects (δ_i). Panel B presents the FD estimates of Equation (2). In Table 3, we regress child outcomes on total disposable income and standard controls including the child's age and sex, number of siblings, father and mother's educational background, survey year, and residential area, but we only present coefficient estimates for income.

(Table 3 around here)

Our OLS estimates show that contemporaneous income is significantly and positively correlated with all ability scores. These results are consistent with previous findings in the United States that there are strongly positive correlations between income and child cognitive outcomes. Putting these results in perspective, our OLS results indicate that an increase of 1 million JPY (approximately 9,000 USD) in family income raises the Japanese and mathematics scores by about 0.018 and 0.038 standard deviations, respectively. These results are similar in magnitude to the previous study by Dahl and Lochner (2012), which shows that a 1,000 USD increase in family income raises mathematics-reading test scores by 0.005 standard deviations. For educational spending, the coefficient estimate of family income is positive but not statistically significant at any conventional level.

Controlling for time-invariant heterogeneity, our FD estimates yield significantly positive income effects for mathematics and combined scores. However, the coefficients are somewhat smaller for FD models and are less precisely estimated in general. A potential reason for these results is that the measurement error is greater for income measured in differences than in levels, suggesting that FD estimates are likely to suffer more from attenuation bias.

OLS estimates can be biased due to correlation between unobserved heterogeneity and family income. For example, a child's innate (time-invariant) ability can be correlated with educational spending since parents might invest more in abler children. At the same time, income can also be higher for families with abler children since parents can also have higher ability. In this case, unobserved children and parents' abilities lead to upward-biased OLS coefficient estimates for educational investment. In fact, the FD model gives a substantially smaller (negative) coefficient estimate of family income on educational spending, which is again not statistically significant.

An important limitation of the FD models is that they remain biased if there are time-varying unobservable characteristics correlated with child outcomes and family income. To deal with this issue, we further estimate FD-IV regressions. Our IV exploits exogenous variations in CAP payments due to policy changes. As discussed earlier, our identification comes from expansion in the CAP's eligible age limits and changes in monthly payments for a child in a given birth cohort.

Table 4 presents our FD-IV estimates of Equation (2).[14] Our FD-IV estimates in columns 1-3 show that family income is not significantly associated with any ability scores, indicating that positive coefficient estimates from OLS and FD models should not be interpreted as causal effects. The table also reports coefficient estimates of our IV in the first-stage regressions together with first-stage F statistics. In all cases, coefficient estimates of the changes in CAP on family income are positive and highly significant, supporting the relevance of our IV in terms of its predictive power in the first-stage

[14] We also estimated models using a simple time difference of allowance payments as an IV. The results are, in most cases, similar to those presented in Table 4.

regressions.

(Table 4 around here)

On the other hand, the coefficient estimate of family income on educational spending appears to be positive and statistically significant. The results in column 4 imply that an increase of 1 million JPY in family income leads to additional spending on a child's education of about 11,222 JPY per month. This can be translated into fairly large income elasticity of educational spending. The implied elasticity evaluated at the sample means is about 2.6.

A cautionary note regarding the above results is that, due to the short time frame of our longitudinal data, our empirical analysis looks only at the causal effects of contemporaneous income on academic achievements of children. Therefore, the interpretation of our empirical results should be that changes in family income do not influence children's academic achievement in the short run, but they cannot preclude the possibility that family income will improve achievement in the longer run. In fact, the positive impact of contemporaneous income on educational spending suggests that increases in family income might improve long-term academic achievement via the investment channel.

6. Heterogeneous Effect

To further examine the relationship between family income and child outcomes, in this section, we investigate whether income effects are heterogeneous. There may be a heterogeneous effect of family income on a child's outcomes and educational spending depending on the child's characteristics or family background. For example, parents with stronger preference for education could spend more time and money for their children if their household budget constraints are affected by changes in the CAP.[15] Another possibility is that economically disadvantaged families might respond more to changes in family income as they face financial/borrowing constraints.

To examine the heterogeneous effect, we estimate our IV regressions of Equation (2) for various population subgroups. Table 5 displays our regression results. The first two rows of Table 5 examine whether income effects are heterogeneous depending on parents' educational status. Specifically, we divide the sample into households with at least one parent having a four-year college degree or above, and those with both parents having a junior college degree or lower. As a result, we could not find any statistically significant coefficient estimates of family income on child achievement for both groups.

[15] Kawaguchi (2016) found the different impacts of school-day reduction on time use and scholastic achievements between parents with higher and lower educational attainment. Kubota (2016) showed that revisions of curriculum guidelines in compulsory education influence the educational expenditure of high-income families but not that of low-income families.

For educational expenditure, the coefficient estimate of family income is slightly larger for families with less-educated parents and is marginally significant (p = 0.102).

(Table 5 around here)

We estimate separate regressions for families above and below the median income in our sample. Again, we could not find any causal impact of family income on children's academic achievements. For educational expenditure, the coefficient estimate for high-income families is almost twice as large as that for low-income families. These results suggest that economically disadvantaged families do not alter their spending behavior in response to income changes. An implication of these results is that increases in family income via CAP expansion might widen the gap between the educational expenditures of high- and low-income families.

Several recent studies suggested that early interventions targeted toward young children are more effective than those targeted toward older children (Cunha et al., 2006). We estimate separate models for children aged 10 or younger versus those aged 11 or older. We could not find any evidence supporting that income at early ages has larger impacts on children's academic achievements than income received at later ages. On the other hand, the income effect on educational spending is substantially larger for older children than for younger ones. The coefficient estimate for older children is almost 2.5 times larger than that for younger children and is marginally significant (p = 0.109).

Finally, we compare the results for boys and girls. The income effects on academic achievements are positive for boys and negative for girls, but in all cases, estimated coefficients are not statistically significant. In comparison, there is substantial difference in the effects of family income on educational spending between boys and girls. The coefficient estimate for girls is almost four times as large as that for boys, and it is statistically significant at the 10% level. In our sample, on average, parents invest slightly less in girls than in boys. Therefore, our results suggest that an increase in family income due to CAP expansion can reduce the investment gap between boys and girls.

7. Conclusion

We use the largely exogenous, discontinuous changes in the CAP in Japan to estimate the causal effects of households' income on child outcomes and educational spending. Our OLS results show that family income is positively correlated with children's cognitive outcomes as well as family's educational investment. FD estimates controlling for time-invariant heterogeneity yield significantly positive income effects for mathematics and combined scores.

Considering the potential endogeneity of family income, we use exogenous changes in child allowance payments as an instrument. Our FD-IV results show that, in most cases, family income tends to have statistically insignificant impacts on a child's cognitive outcomes. For the household's educational spending, on the other hand, we find some evidence of a positive income effect. To examine the heterogeneous effect, we estimate FD-IV regressions for various population subgroups: those divided by parental education, income levels, children's age, and gender. We find that family income does not have causal impacts on children's cognitive outcomes across subgroups. For households' educational spending, we find that an exogenous increase in family income raises educational spending for high-income families and for girls.

Our empirical findings suggest that contemporaneous income does not have any causal impact on a child's cognitive outcomes in the short term. However, given that contemporaneous income tends to increase educational spending even after controlling for the endogeneity of family income, family income could influence child outcomes in the longer term.

Addressing the long-term influence of household income on child cognitive and non-cognitive outcomes, if any, is difficult using our current data set and the degree of policy variations in the past 10 years in Japan. The Japanese government under the Abe Administration is discussing a sizable and permanent increase in the subsidy to preschool and higher education. If such policies are implemented, there will be a chance to identify the effects of permanent changes in education costs and short-term changes in the CAP on child outcomes in Japan separately.

References

[1] Akabayashi, H., R. Nakamura, M. Naoi and C. Shikishima (2016) "Toward an International Comparison of Economic and Educational Mobility: Recent Findings from the Japan Child Panel Survey," *Educational Studies in Japan*, 10, 49–66.

[2] Akabayashi, H., M. Naoi and C. Shikishima (2016) *An Economic Analysis of Academic Ability, Non-Cognitive Ability, and Family Background: Primary Findings from a Panel Survey of Japanese School-Age Children*, Tokyo, Japan: Yuhikaku (in Japanese).

[3] Akee, R. K. Q., W. E. Copeland, G. Keeler, A. Angold and E. J. Costello (2010) "Parents' Incomes and Children's Outcomes: A Quasi-Experiment Using Transfer Payments from Casino Profits," *American Economic Journal: Applied Economics*, 2(1), 86–115.

[4] Becker, G. S. (1962) "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy*, 70(5), 9–49.

[5] Becker, G. S. (1967) Human Capital and the Personal Distribution of Income: An Analytical Approach," in G.S. Becker (ed.). *Human capital* (2nd ed.), Chicago, IL: University of Chicago Press.

[6] Belley, P. and L. Lochner (2007) "The Changing Role of Family Income and Ability in Determining Educational Achievement," *Journal of Human Capital*, 1(1), 37–89.

[7] Blau, D. M. (1999) "The Effect of Income on Child Development," *Review of Economics and Statistics*, 81(2), 261–276.

[8] Cameron, S. V. and C. Taber (2004), "Estimation of Educational Borrowing Constraints Using Returns to Schooling," *Journal of Political Economy*, 112(1), 132–182.

[9] Carneiro, P. and J. J. Heckman (2002) "The Evidence on Credit Constraints in Post-Secondary Schooling," *Economic Journal*, 112, 705–734.

[10] Coleman, J. S., E. Q. Campbell, C. J. Hobson, J. McPartland, A. M. Mood, F. D. Weinfeld, and R. L. York (1966) *Equality of Educational Opportunity*, Washington, DC: Government Printing Office.

[11] Cunha, F., J. J. Heckman, L. Lochner and D. V. Masterov (2006) "Interpreting the Evidence on Life Cycle Skill Formation," in E. A. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*, Volume 1, Chapter 12, pp. 697–812, Amsterdam: North Holland.

[12] Dahl, G. B. and L. Lochner (2012) "The Impact of Family Income on Child Achievement: Evidence from the Earned Income Tax Credit," *American Economic Review*, 102(5), 1927–1956.

[13] Doi, T (2010) "The Effect of the Introduction of Child Benefit on Households: Micro-simulation using JHPS," *Keizai-Kenkyu*, 61(2), 137–153 (in Japanese).

[14] Duncan, G. J. and J. Brooks-Gunn (1997) *Consequences of Growing Up Poor*, New York: Russell Sage Foundation.

[15] Duncan, G. J., W. J. Yeung, J. Brooks-Gunn and J. R. Smith (1998) "How Much Does Childhood Poverty Affect the Life Chances of Children?" *American Sociological Review*, 63(3), 406–423.

[16] Hambleton, R. K. and H. Swaminathan (1985) *Item Response Theory: Principles and Applications*, Boston, MA: Kluwer Academic.

[17] Kawaguchi, D. (2016) "Fewer Days, More Inequality," *Journal of the Japanese and International Economies*, 39, 35–52.

[18] Keane, M. P. (2002) "Financial Aid, Borrowing Constraints, and College Attendance: Evidence from Structural Estimates," *American Economic Review*, 92(2), 293–297.

[19] Kobayashi, Y. (2011) "The Effects of Child Benefit Payments on Household," *Quarterly of Social Security Research*, 47(1), 67–80 (in Japanese).

[20] Kubota, K. (2016) "Effects of Japanese Compulsory Educational Reforms on Household Educational Expenditure," *Journal of the Japanese and International Economies*, 42, 47–60.

[21] Lord, F. M. (1980) *Applications of Item Response Theory to Practical Testing Problems*, Hillsdale, NJ: Edbaum.

[22] Løken, K. V. (2010) "Family Income and Children's Education: Using the Norwegian Oil Boom as a Natural Experiment," *Labour Economics*, 17(1), 118–129.

[23] Mayer, S. E. (1997) *What Money Can't Buy: Family Income and Children's Life Chances*, Cambridge, MA: Harvard University Press.

[24] Shikishima, C. (2013) "Overview of the Japan Child Panel Survey 2012," Keio University Panel Data Research Center, SDP2012-002 (http://www.pdrc.keio.ac.jp/en/SDP2012-002.pdf).

[25] Shikishima, C., M. Naoi., J. Yamashita and H. Akabayashi (2013) "Japan Child Panel Survey: Reliability and Validity of the Academic Ability Test," Keio University Panel Data Research Center, SDP2012-006 (http://www.pdrc.keio.ac.jp/en/SDP2012-006.pdf).

[26] Stephens, M., Jr., and T. Unayama (2015) "Child Benefit Payments and Household Wealth Accumulation," *Japanese Economic Review*, 66(4), 447–465.

[27] Takaku, R. (2015) "The Effects of Child Benefits on the Parent's Psychological Well-Being: Evidence from Low- and Middle-Income Families," *Quarterly of Social Security Research*, 50(4), 433–445 (in Japanese).

[28] Unayama, T. (2011) "The Effects of Child Benefits on Household Consumption," RIETI Discussion Paper, 11-J-021 (in Japanese) (http://www.rieti.go.jp/jp/publications/dp/11j021.pdf)

Table 1: Description of the Child Allowance Policy in Japan

<table>
<tr><th rowspan="2">Year[*]</th><th rowspan="2">Age limit</th><th rowspan="2">Age brackets</th><th colspan="2">Monthly benefit by birth order</th><th>Earnings tests</th></tr>
<tr><th>First/second</th><th>Third+</th><th>(Upper lim., 0000s JPY)</th></tr>
<tr><td>1992</td><td>3</td><td>All</td><td>5,000</td><td>10,000</td><td>Yes (670.0)</td></tr>
<tr><td>2000</td><td>6</td><td>All</td><td>5,000</td><td>10,000</td><td>Yes (780.0)</td></tr>
<tr><td>2004</td><td>9</td><td>All</td><td>5,000</td><td>10,000</td><td>Yes (780.0)</td></tr>
<tr><td>2006</td><td>12</td><td>All</td><td>5,000</td><td>10,000</td><td>Yes (860.0)</td></tr>
<tr><td>2007</td><td>12</td><td>Age < 3</td><td colspan="2">10,000</td><td>Yes (860.0)</td></tr>
<tr><td></td><td></td><td>3 ≤ Age ≤ 12</td><td>5,000</td><td>10,000</td><td></td></tr>
<tr><td>2010</td><td>15</td><td>All</td><td colspan="2">13,000</td><td>No</td></tr>
<tr><td>2011[†]</td><td>15</td><td>Age < 3</td><td colspan="2">15,000</td><td>No</td></tr>
<tr><td></td><td></td><td>3 ≤ Age ≤ 12</td><td>10,000</td><td>15,000</td><td></td></tr>
<tr><td></td><td></td><td>13 ≤ Age ≤ 15</td><td colspan="2">10,000</td><td></td></tr>
<tr><td>2012</td><td>15</td><td>Age < 3</td><td colspan="2">15,000</td><td>Yes (960.0)</td></tr>
<tr><td></td><td></td><td>3 ≤ Age ≤ 12</td><td>10,000</td><td>15,000</td><td></td></tr>
<tr><td></td><td></td><td>13 ≤ Age ≤ 15</td><td colspan="2">10,000</td><td></td></tr>
</table>

Notes: [*]Unless otherwise noted, the law was enforced from April of the year the policy changed. [†]The law was enforced from October 2011. Figures of the earning limit are applied to salaried worker households.

Table 2: Descriptive statistics

	Mean	Standard deviation	Min	Max	N
Dependent variables					
Japanese ability score	-0.092	1.033	-3.708	2.480	2,340
Mathematics ability score	-0.054	1.227	-4.926	2.785	2,340
Combined ability score	-0.073	1.044	-4.232	2.633	2,340
Monthly educational spending (in ten thousand JPY)	2.742	2.705	0.125	34.947	1,937
Independent variables					
Family income(in million JPY)	6.480	2.728	0.060	22.396	2,340
Girl	0.490	0.500	0.000	1.000	2,340
Number of sibilings	2.210	0.773	1.000	6.000	2,340
Father's educational background					
Junior high school	0.022	0.146	0.000	1.000	2,107
High school	0.428	0.495	0.000	1.000	2,107
Junior college	0.122	0.327	0.000	1.000	2,107
Four-year college or post-graduate degree	0.429	0.495	0.000	1.000	2,107
Mother's educational background					
Junior high school	0.006	0.076	0.000	1.000	2,094
High school	0.453	0.498	0.000	1.000	2,094
Junior college	0.373	0.484	0.000	1.000	2,094
Four-year college or post-graduate degree	0.169	0.374	0.000	1.000	2,094

Table 3: OLS and FD estimates of the effects of family income on ability scores and educational spending

Panel A: OLS

	Japanese ability score	Mathematics ability score	Combined ability score	Monthly educational spending
Family income (in million JPY)	0.0177***	0.0379***	0.0278***	0.0073
	(0.0066)	(0.0070)	(0.0059)	(0.0334)
N	1,943	1,943	1,943	1,625

Panel B: FD

ΔFamily income	0.0064	0.0339**	0.0201*	-0.1281
	(0.0133)	(0.0147)	(0.0104)	(0.0970)
N	756	756	756	558

Notes: ***, **, and * indicate that the estimated coefficients are statistically significant at the 1%, 5%, and 10% levels, respectively. Robust standard errors are in parentheses. We also control for a child's age and sex, number of siblings, father and mother's educational background, survey years, and location of residence.

Table 4: FD-IV estimates of the effects of family income on ability scores and educational spending

	FDIV			
	Japanese ability score	Mathematics ability score	Combined ability score	Monthly educational spending
	(1)	(2)	(3)	(4)
Difference in family income	-0.0304	0.0739	0.0218	1.1222**
	(0.0870)	(0.0980)	(0.0652)	(0.5624)
First stage				
Coefficient of	3.4009***	3.4009***	3.4009***	2.8043***
instrumental variable	(0.9178)	(0.9178)	(0.9178)	(1.0152)
F-value	13.7323	13.7323	13.7323	7.6302
N	756	756	756	558

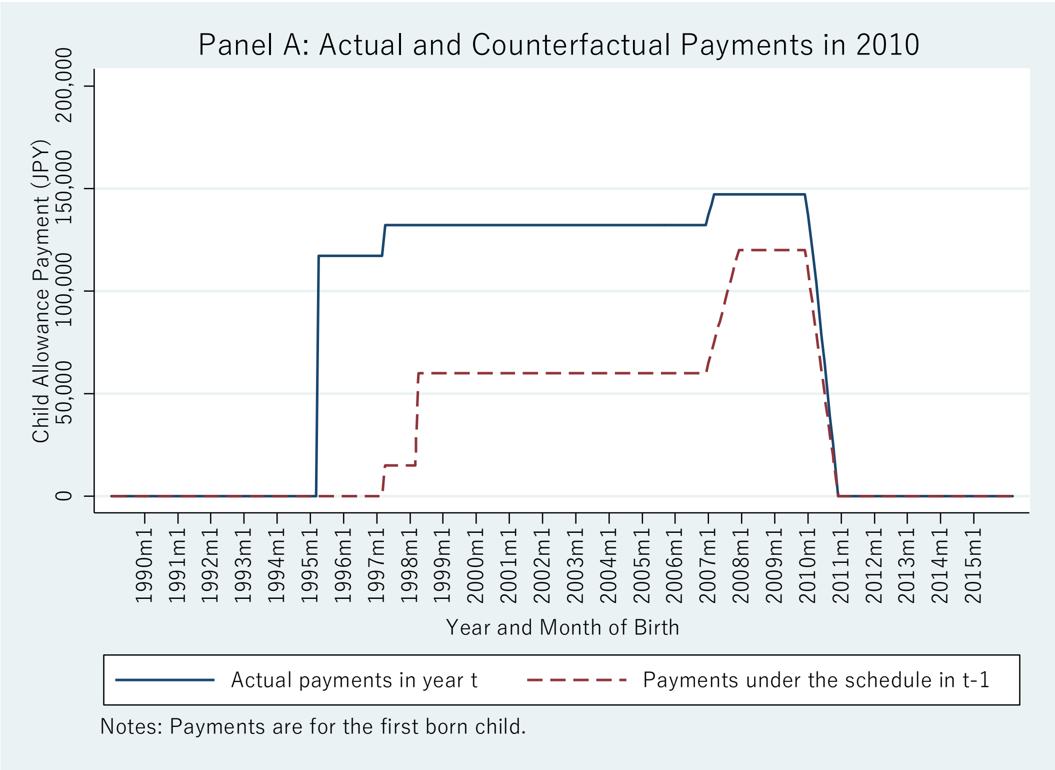
Notes: ***, **, and * indicate that the estimated coefficients are statistically significant at the 1%, 5%, and 10% levels, respectively. Robust standard errors are in parentheses. We also control for a child's age and sex, number of siblings, father and mother's educational background, survey years, and location of residence.

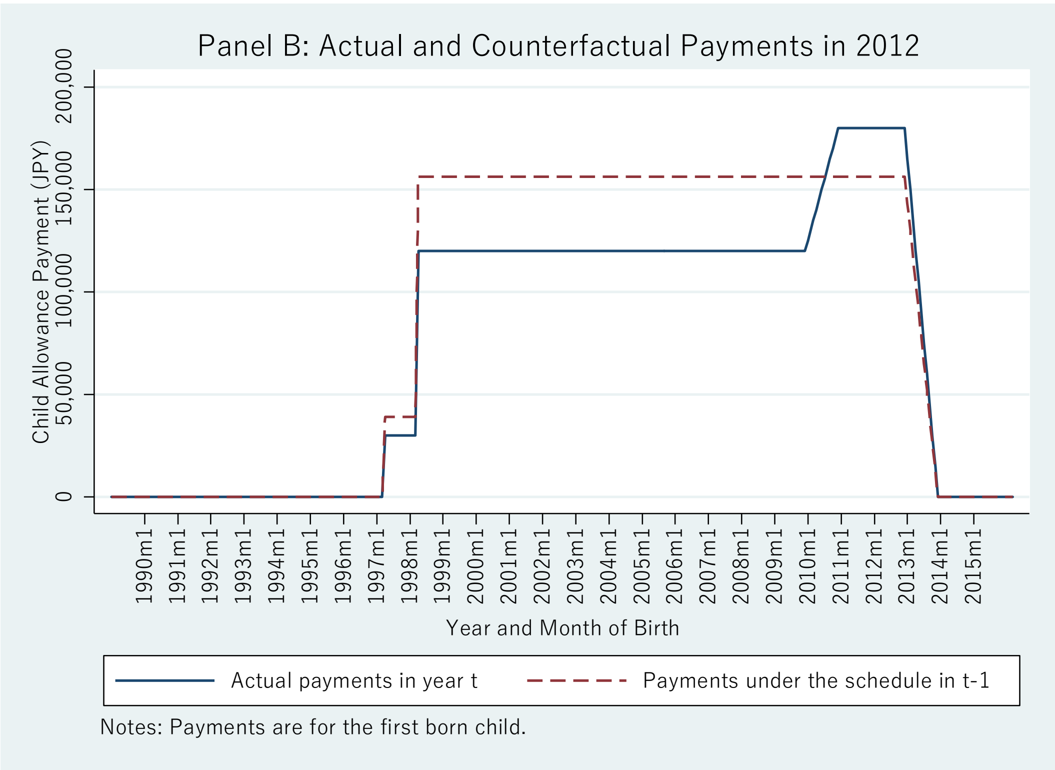
Table 5: FD-IV estimates of the effects of family income for various subgroups

	Parents' education	Family income	Age	Sex
	Either mother or father with university or above degree	Low income	Grades 1-3	Boys
Japanese ability score				
Effect of Δfamily income	0.0090	-0.0580	-0.0013	0.0276
	(0.1050)	(0.1898)	(0.1235)	(0.1186)
First stage F-value	7.1400	3.2489	6.7169	7.5661
N	364	406	412	376
Mathematics ability score				
Effect of Δfamily income	0.1092	0.2238	0.0328	0.2124
	(0.1159)	(0.2582)	-0.1213	(0.1477)
First stage F-value	7.1400	3.2489	6.7169	7.5661
N	364	406	412	376
Combined ability score				
Effect of Δfamily income	0.0591	0.0829	0.0157	0.1200
	(0.0817)	(0.1510)	(0.0869)	(0.1015)
First stage F-value	7.1400	3.2489	6.7169	7.5661
N	364	406	412	376
Monthly educational spending				
Effect of Δfamily income	0.7573	0.6300	0.6789	0.4554
	(0.7125)	(0.7017)	(0.5878)	(0.5295)
First stage F-value	3.8260	4.4307	2.9356	3.4041
N	257	302	306	274
	Both parents with junior college or lower degree	High income	Higher than grade 4	Girls
Japanese ability score				
Effect of Δfamily income	-0.1198	-0.0158	-0.0989	-0.0778
	(0.1325)	(0.0960)	(0.1549)	(0.1344)
First stage F-value	7.5156	9.5678	4.0127	5.6205
N	392	350	344	380
Mathematics ability score				
Effect of Δfamily income	-0.0528	-0.0159	0.1299	-0.1667
	(0.1551)	(0.1062)	(0.1847)	(0.1883)
First stage F-value	7.5156	9.5678	4.0127	5.6205
N	392	350	344	380
Combined ability score				
Effect of Δfamily income	-0.0863	-0.0158	0.0155	-0.1223
	(0.1067)	(0.0743)	(0.1150)	(0.1207)
First stage F-value	7.5156	9.5678	4.0127	5.6205
N	392	350	344	380
Monthly educational spending				
Effect of Δfamily income	0.9253	1.2035*	1.6901	1.8168*
	(0.5663)	(0.6352)	(1.0535)	(1.0859)
First stage F-value	5.6817	6.0327	3.6844	3.8971
N	301	256	252	284

Notes: ***, **, and * indicate that the estimated coefficients are significant at the 1%, 5%, and 10% levels, respectively. Robust standard errors are in parentheses. We also control for a child's age and sex, number of siblings, father and mother's educational background, survey year, and location of residence.

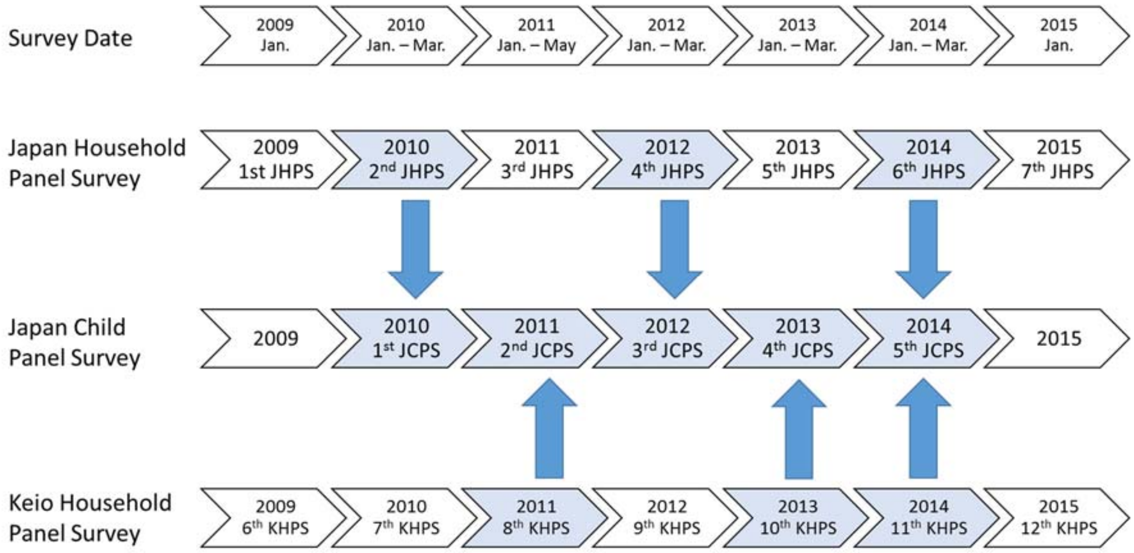
Figure 1. Child allowance schedule by age cohort





Note: Calculated by the authors based on Child Allowance Law.

Figure 2: Timeline of the Japan Child Panel Survey (JCPS)



Note: We add modifications based on supplements provided by the Panel Data Research Center at Keio University to Akabayashi et al. (2016; Figure 2).