Long-Term Effects of Coeducational Industrial Arts and Home Economics Classes

Hiromi Hara

Japan Women's University

Núria Rodríguez-Planas

City University of New York (CUNY), Queens College

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Abstract

We find that a Japanese education reform that eliminated gender-segregated and gender-stereotyped industrial arts and home economics classes in junior high schools in 1990 led to behavioral changes among these students some two decades later when they were married and in their early forties. Using Regression Discontinuity and Japanese time-use data from 2016, we find that the reform led to a reduction in the gender gaps in weekend home production, labor market attachment, and annual labor income. While the gender convergence within the household is driven by both men increasing and women decreasing their time in home production on the weekend, the convergence in the labor market is solely driven by women increasing their share of employment in regular jobs, which also led to a reduction of the gender income gap. Evidence also suggests that the reform delayed fertility among men. We present suggestive evidence that this behavioral gender convergence may have been driven by changes in gender norms.

Keywords: junior high school, coeducation of home economics, gender gaps, time-use data, employment and labor income, and fertility.

JEL classification: J22, J24, I2

Authors' contact: Hiromi Hara, Japan Women's University, Department of Social and Family Economy, 2-8-1 Mejirodai, Bunkyo-ku, Tokyo 112-8681, Japan. E-mail: harahiromi@fc.jwu.ac.jp. Núria Rodríguez-Planas, Queens College - CUNY, Economics Department, Powdermaker Hall, 65-30 Kissena Blvd., Queens, New York 11367, USA. Email: nuria.rodriguezplanas@qc.cuny.edu.

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1. Introduction

Despite the great convergence in the lives of men and women, especially in the labor market (Goldin 2014), women continue to shoulder a disproportionate burden at home. On the one hand, gender disparities in the division of domestic work hold back women's professional careers. On the other, wives' greater involvement in household chores and child care may also affect the hiring and promotion decisions of employers regarding women, stalling gender convergence in the labor market. While more than 70% of Japanese women aged 15 to 64 worked in 2018, only 44% did so on a full-time permanent contract.[1] The majority either worked part-time or on a fixed-term contract, reinforcing a large pay gap between men and women.

At the same time, Japan has one of the highest disparities in the division of domestic work, with Japanese husbands with children under six years old spending only 1 hour and 23 minutes per day on housework and childcare, the shortest time among the developed countries.[2] These disparities are likely reinforced by Japanese well-defined social norms regarding traditional gender roles and society's demanding domestic expectations for wives. Despite a significant decrease in the share of Japanese who agree with the statement "married women should stay at home," in 2018 still 37% of the population agreed with it.[3] Furthermore, over 83% of Japanese agreed with the statement "if a woman earns more money than her husband, it is almost certain to cause problems," the highest share among World Value Survey participating countries (wave 6, 2010-2014).

In this paper, we analyze the causal effect of a 1990s Japanese junior high school[4] education reform on subsequent behavioral changes among adult married males and females within and outside the household. More specifically, we study the long-term consequences of an education reform that ended over 30 years of gender segregation and stereotyping in *industrial arts and home economics (IA-HE hereafter)* classes in Japanese junior high schools and instead began offering boys and girls the same IA-HE curriculum, taught co-educationally.

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[1] Statistics Bureau of Japan, *Labor Force Survey 2018*.

[2] Statistics Bureau of Japan, *Survey on Time Use and Leisure Activities 2016.* In contrast, American men spend an average of 2 hours and 21 minutes per day on housework and childcare (American Time Use Survey 2016), and European men over 2 and a half hours (Eurostat 2004).

[3] NHK Broadcasting Culture Research Institute, *The Japanese Value Orientations Survey 2018* (Nihonjin no ishiki chosa in Japanese).

[4] Japanese junior high schools cover grades 7 to 9. While junior high schools are uncommon in the US, middle schools, which tend to cover grades 6 to 8, would be the comparable framework.

Beyond teaching students to become independent in their daily lives by cooking, washing clothes and cleaning rooms, the curriculum in home economics in Japanese schools is "carefully designed to get children to value cooperation in the home and examine their own roles as contributing members of a family. It encourages them to think about what kind of life, and what kind of household, they should have as adults" (The Japan Times, November 16, 2001). As Kawamura (2016) explains, home economics "may provide a good opportunity for all students to discover new things and widen their cultural perceptions. Some students have already experienced something in their home, but experiences with their friends and teacher in *katei-ka* (home economics) classes could widen their viewpoints even more. In other words, *katei-ka* can encourage students in their daily lives, and promote them to be more conscious in their lives."

Since the reform was implemented at the beginning of the 1990 school year, the first cohort to receive co-educational home economics and industrial arts during the three years of junior high school is the cohort born between April 1st 1977 and March 31st 1978, referred hereafter as the 1977 cohort. Using a Regression Discontinuity design and Japanese 2016 time-use data,[5] we analyze whether the introduction of the junior high school education reform on April 1st 1990 *caused* a behavioral change among these students more than two decades later, when they were married men and women in their late thirties/early forties. Among the behavioral changes we study are: time spent in home production by men and women during weekdays and weekends, preferences for children (measured by total number of children born by 2016 when the youngest cohort was 37 years old), and women's labor market preferences—measured by hours worked, type of employment, and labor income. The analysis is done separately for men and women.

Our findings suggest that this education reform, which mainly eliminated gender-segregated and gender-stereotyped IA-HE courses in junior high school, was successful in modifying treated individuals' long-term behavior. The reform closed the gender gaps in weekend home-production and weekend job-related activities by increasing men's engagement in traditionally female activities (home-production) and decreasing their engagement in traditionally male activities (time spent in job-related activities), and the opposite for women. More specifically, we find that men affected by the reform increased their weekend home-production time by 20 minutes per day (or 18%) and their share of the couple's weekend home-production time by 2.3 percentage points or 13%. At the same time, the reform reduced women's home-production weekend time by 16 minutes (or 5%) and their share of the couple's weekend home-production time by 1.3 percentage points (or 1.6%). Further, the reform also affected the weekend distribution of home-production time among spouses. While males increased their time on childcare and other home-production

[5] The formal name of the Japanese time-use data is the *Survey on Time Use and Leisure Activities* (*Syakai-Seikatsu-Kihon-Chosa* in Japanese) conducted by the Statistics Bureau of Japan.

activities, which includes grocery shopping, caregiving to sick children and the elderly, and travel time for home production, their wives decreased their weekend time spent on those same activities. Similarly, treated women reduced their weekend home-production activities at the expense of their husbands, whose time increased by 15 minutes. Lastly, the reform also reduced the gender gap in weekend time spent in job-related activities, as treated men reduced their weekend time in job-related activities by 30 minutes while women increased it by 13 minutes.

We also find that the reform increased women's regular employment by 5 percentage points (or 20%) and wages by 5%, with no effect on male employment outcomes, hence reducing the gender gap in both regular employment and annual labor income. The evidence also seems to indicate that the reform delayed fertility among men but had no effect on women's fertility. Finally, evidence that the reform increased the number of women who disagree with statements such as "the husband should work outside and the wife should protect the family" or "if the husband has enough income, the wife should not have a job" suggests that the reform may have had a mediating effect on women's perception of gender norms. These findings are robust to a battery of sensitivity checks as well as placebo tests.

While our work contributes to a recent but growing literature on how individuals allocate time between market and non-market activities,[6] this research is most directly related to the following two studies. First, it speaks to recent work by Dahl, Kotsadam, and Rooth (2018) on whether working side-by-side with women in a traditionally male-dominated setting has an impact on attitudes about productivity and gender roles. In that study, the authors analyze a field experiment whereby females are recruited to some Norwegian military squads but not others during an 8-week boot camp to see if men adopt more egalitarian attitudes. They find an increase in the share of men who think mixed-gender teams perform as well or better than same-gender teams and who think household work should be shared equally. Second, this paper relates to an evaluation of a school-based randomized program that engaged 7th to 10th grade students in India in classroom discussions about gender equality (Dhar, Jain and Jayachandran 2018). That study finds that the intervention made gender attitudes more progressive and produced more gender-equal behavior, especially among boys who reported doing more household chores. While these two related studies focus on the short-run effects of these interventions on reshaping (mostly) gender attitudes, our work focuses instead on

[6] Several authors have analyzed how individuals modify their time use between market and non-market activities as a response to temporary changes (Hamermesh 2002; Burda and Hamermesh 2010) or permanent changes (Lee, Hamermesh and Kawaguchi 2012; Stancanelli and van Soest 2012; Kawaguchi, Lee, Hamermesh 2013; Goux et al. 2014) in the time available for market work, or to shocks to market childcare prices (Cortés and Tessada 2010; Amuedo-Dorantes and Sevilla 2014).

whether the Japanese education reform generated more gender-equal behavior within and outside the household in the long run.

The structure of this paper is as follows. Section 2 explains the institutional background and the reform. Section 3 explains the regression discontinuity design, while Section 4 presents the data and validates the identification strategy. Sections 5 and 6 present the main findings, the robustness analysis (including placebo tests), and subgroup analysis. Section 7 explores the effect of the reform on fertility and gender norms, and Section 8 concludes the paper.

2. The Japanese Education System and the Reform

Japanese Education System Prior to the Reform

Compulsory schooling in Japan begins at age six and consists of six years of primary school and three years of junior high school, after which most students proceed to high school. Compulsory schooling is mostly public and co-educational,[7] with students not separated into ability groups or gifted classes. Importantly for our analysis, students are not advanced a grade if they are perceived to be exceptionally able, nor are they held back if they are having difficulty (OECD 2010). Hence, individuals enter first grade the year in which they are six years old on April 1, which is when the academic school year begins in Japan, and they continue with the same cohort until they graduate.

The Japanese education system is regulated at the national level, including the setting of national curriculum standards that define the content to be taught by grade and subject. To guarantee faithful implementation of this curriculum across the country, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT), with advice from the Central Council for Education and the assistance of university professors and ministry staff, publishes detailed curriculum guidelines in the *Government Guidelines for Education (GGE)*. In addition, MEXT funds each of the 47 prefectures (the government jurisdiction between the county and national level which implements national policy at the local level) and provides them with detailed explanatory booklets for each subject and grade level so that instruction is based on the national curriculum standards throughout the country.

[7] Private school and same-sex education in junior high school is uncommon in Japan. The percentage of private junior high schools was 5.4% in 1990 and 7.6% in 2018 (*The School Basic Survey* by MEXT). Based on our calculations using data from *The School Basic Survey*, we estimate that the percentage of single-sex junior high schools was less than 3% during the 2017-18 academic year.

Japan is recognized by the OECD (2010) as having very little flexibility to adapt or modify the national curriculum, which requires students to take five core subjects (Japanese, social studies, mathematics, science, and foreign language), music, arts, physical education, and industrial arts and home economics (*gijutsu-katei,* IA-HE), which covers a wide range of skills from cooking, baby and child caring, meal planning, grocery shopping and sewing to building electronic circuits and constructing wooden furniture. Home economics was first introduced in 1947 as one of six areas[8] covered in a new compulsory course offered to all children from 5th grade to high school. According to Yokoyama (1996), soon thereafter, this course was restructured into two courses, occupation and home economics, with boys specializing in the former and girls in the latter. In 1958, Japan's desire to promote science and technology education prompted another revision of the GGE by which this course was renamed IA-HE, with industrial arts (wood shop, machinery, and electronics) offered to boys and home economics (cooking, family, clothing and homemaking) to girls. Importantly, boys and girls were taught IA-HE during the same period but in physically segregated rooms—the school shop and the home economics room— instilling and perpetuating gender stereotypes during adolescence. This was in stark contrast with the core subjects, which were taught co-educationally in the students' homeroom.

In 1978, another GGE revision divided industrial arts into nine areas (wood-shop I and II, metal-shop I and II, machinery I and II, electronics I and II, and horticulture), and home economics into eight areas (clothing I, II, and III; food I, II, and III; housing; and nursing). It also required junior high-school boys to choose five areas from technology education and one from home economics, and junior high-school girls to choose one area from industrial arts and five areas from home economics. Hence, most of the content (83%) of IA-HE education continued to be differentiated by gender and, crucially, gender segregation also persisted, as boys and girls continued to be taught in physically segregated classrooms. It was not until the 1989 GGE reform that gender-segregated and gender-stereotyped IA-HE junior high-school education was completely abolished.

The Reform: Coeducation in 1990

In 1980, concerns about Japan's international reputation prompted the Japanese government to sign the United Nations *Convention on the Elimination of all Forms of Discrimination against Women* (CEDAW). However, in order to ratify the CEDAW, Japan needed to overcome several gender inequality hurdles in

[8] The six subject areas included agriculture, industry, business, fisheries, vocational guidance, and home economics.

three areas: nationality, employment, and education.[9] With respect to education, concerns were raised that in Japan, the IA-HE junior high-school course physically and content-wise segregated boys and girls. After pressure from the Ministry of Foreign Affairs, the Ministry of Education agreed to revise the IA-HE education in March 1984 with the creation of the Panel on Home Economics Education whose objective was to draft new regulations that would eliminate gender discrimination within junior high school IA-HE.

In March 1989, the Ministry of Education published new guidelines prohibiting any differential treatment between boys and girls in IA-HE junior high-school education. The new regulations required IA-HE to be taught co-educationally in the same physical room. In addition, it restructured its content into eleven subject areas: wood-shop, electronics, family life, food, metal-shop, machinery, horticulture, information technology, clothing, housing, and nursing, and made the first four subject areas compulsory for both boys and girls. Moreover, it allowed schools to choose three additional subject areas among the other seven (to be taught to both boys and girls) based on the characteristics of both the schools' region and student population. The 1989 GGE reform thus brought an end to over 30 years of gender segregation in IA-HE junior high-school education. It was implemented in the 1990 school year.

Students attend two classes of IA-HE per week and each class lasts about 50 minutes. Before the reform, students were required to take 245 classes of IA-HE over the three years of junior high school, of which boys took between 20 and 35 classes in home economics and the rest in industrial arts, while girls took between 210 and 225 classes in home economics and the rest in industrial arts. After the reform, the total number of classes of IA-HE required over the three years of junior high school ranged from 210 to 245 classes, with both boys and girls required to take a minimum of 70 classes in both subjects (industrial arts and home economics). For the other 70 to 105 classes, schools had discretion on which combination of industrial arts and home economics classes to offer as long as this combination was the same for both boys and girls and taught co-educationally.

Since the reform was implemented at the beginning of the 1990 school year, the first cohort to receive three full years of co-educational junior high-school IA-HE is the cohort born after April 1, 1977; hereafter, the 1977 cohort (See Appendix Figure A1). While the majority of the entering 7th grade students began co-educational IA-HE during the 1990 school year, most 8th and 9th grade students continued with

[9] In terms of nationality, Japanese women married to foreign nationals could not give Japanese nationality to their children (while Japanese men married to foreign nationals could). The ratification of CEDAW led to the elimination of this gender asymmetry. In the labor market, men and women were also treated differently, and the Equal Employment Opportunity Act for Men and Women enacted in 1985 addressed the gender-differential treatment in this domain. To the extent that these changes affected all cohorts equally, they are not a threat to our identification strategy.

gender-segregated IA-HE education because of the limited availability of IA-HE teachers and facilities (Yasuno 1991). Indeed, according to Yasuno (1991), during that year, 88% of junior high schools in Hyogo prefecture introduced IA-HE coeducation in 7th grade compared to only 41% in 8th grade and 16% in 9th grade.[10] Even though some students from the 1975 and 1976 cohorts may have been taught IA-HE co-educationally, this was for only one or two years as opposed to the full three years of junior high school, and only after they had already experienced gender-segregated IA-HE for at least one year. It is therefore likely that gender stereotypes will have already been formed, making it difficult for one or two later years of coeducation in IA-HE to reverse them. However, as both the 1975 and 1976 cohorts are included in our pre-reform group, our estimates are thus the lower bounds of the effect of the reform to the extent that these two cohorts may have been partially impacted by one or two years of co-educational home economics in junior high school.

3. Econometric Framework

Our aim is to explore whether the introduction of co-educational IA-HE courses in junior high schools in Japan in 1990 caused a behavioral change among those students several decades later when they were married and in their late thirties or early forties. Among the behavioral changes we study are the total daily minutes of home production, leisure, life-support activities, and market work during both weekdays and weekends,[11] other labor market outcomes (regular versus non-regular job, self-employment, non-employment, occupation and annual earnings) and fertility. The analysis is conducted separately for married men and women.

We take advantage of a sharp discontinuity across cohorts in the co-educational nature of the IA-HE curriculum and pedagogy during junior high school—from some (one to three full years of) gender-segregated and gender-stereotyped education to three years of coeducation—that took place beginning April 1, 1990, when the Japanese government implemented the reform. Our model implements a regression discontinuity (RD) design, in which treatment status (receiving three years of co-educational IA-HE during junior high school) is a deterministic and discontinuous function of time. Academic year of birth (D_i) is the running variable[12] that determines whether individual i is exposed to full treatment or not and it is normalized to 0 at the cut-off, which is April 1977. The empirical specification is:

[10] Hyogo prefecture is located in the western part of Japan and is a commercial center of the country.

[11] The analysis distinguishes between weekdays and weekends as they each have distinct patterns of time use.

[12] Using the month and year of birth from JTUS, we assigned individuals to their academic year.

$$Y_i = \alpha + \beta Post_{1977} + \delta X_i + \sum_{k=2}^{47} \mu_k(\pi_j) + \sum_{m=2}^{7} \eta_m(Q_m) + [(1 - Post_{1977}) \times f_0(D_i)] + [Post_{1977} \times f_1(D_i)] + \varepsilon_i \quad (1)$$

where Y_i is the outcome variable for individual i. $Post_{1977}$ is a dummy variable taking a value of one for all individuals who were born after April 1977 and hence began junior high school after the implementation of reform and zero otherwise. The vector X_i contains variables that control for individual i's socio-demographic characteristics such as their highest educational attainment or whether they live in a three-generation household. As these controls may be endogenous, they are not included in our preferred specification, but instead are used as robustness checks. In some specifications, X_i will also control for the number of children and the presence of children under ten years old in the household. In addition to prefecture j fixed effects, $\{\pi_j\}_{j=2}^{47}$, which capture institutional and structural differences across prefectures, we also include controls for the day of the week the time-use survey took place, $\{Q_m\}_{m=2}^{7}$.[13] We allow for a different trend $f_j(D_i)$ before ($j = 0$) and after ($j = 1$) the reform implementation date. In our baseline specification, $f_j(D_i)$ is a linear function, but in the sensitivity analysis in Section 6, we present alternative specifications with different windows around the threshold (from 3 to 10 years), as well as different orders of the polynomial in the running variable. We also report the results of a "donut" specification that excludes the two years immediately before the cutoff year to show the robustness of our results because the 1975 and the 1976 cohorts might have been only partially affected by the reform, as noted above.

The coefficient of interest, β, captures the causal effect of the junior high school reform on the outcomes of married individuals such as their daily time use in 2016. Note that at the cutoff point, individuals were born in April 1977, so $f_j(0) = 0$ for $j = 0, 1$. Hence, any causal effect associated with the implementation of the reform will be absorbed by our coefficient of interest, β. For example, a positive and statistically significant β would provide evidence that the junior high-school reform increased married individuals' daily time use within the household decades later.

Identification comes from assuming that the underlying potentially endogenous relationship between ε_{ijt} and the year and month of birth is eliminated by the flexible functions $f_0(D_i)$ and $f_1(D_i)$ that absorb any smooth relationship between the birth year and month and ε_i. To put it differently, the polynomial cohort trend, $f_j(D_i)$, controls for any variation in an individual's outcome variable that would

[13] Monday through Friday dummy variables represent weekdays, and Saturday and Sunday dummy variables represent weekends.

have occurred in the absence of the reform, picking up smooth changes in that outcome variable caused by other policies that take effect slowly over time. Crucially, these flexible linear cohort trends control for potential variation arising from observations further and further away from the threshold. We also allow these trends to differ on either side of the implementation date to increase flexibility in our specification.

Our identifying assumption is that having begun junior high school (attended 7th grade) during the 1990 school year is as good as random. If this assumption holds, we expect to observe no bunching in the number of births around the cut-off date, and balanced socio-demographic characteristics around the threshold, on average. We test for these implications in Section 4.

4. Data

This study utilizes micro data from the nationally representative *Japanese Time-Use Survey* (JTUS). By conducting this survey every five years since 1976, the Statistics Bureau of Japan collects the most comprehensive and reliable data on daily time-allocation patterns, including total daily minutes of childcare time, housework, market work, and any other use of time. Because we are interested in analyzing how a junior high school education reform in 1989 affected the long-run time-use distribution of home production within households, it is important that we observe these individuals several years after they have formed their family. Hence, we focus our analysis on the 2016 JTUS because, by that time, cohorts that had begun junior high school three years before and after the 1990 academic year when the reform was implemented were now between 37 and 42 years old.[14]

JTUS adopts a two-stage stratified sampling method in which enumeration districts (ED) from each of the 47 prefectures are selected in the first stage and, within each selected ED, households are selected in the second stage. Within the selected households, all individuals 10 years old or older are asked to respond to the survey. In 2016, the JTUS collected time-use information on 176,285 individuals (83,670 of whom were men) from 76,553 households. This information was collected during two consecutive days within the nine-day period from October 15-23, 2016. For each of these two days, the individual was asked to provide information on time use via a pre-coding questionnaire,[15] which divides the 24 hours in a given day into 96

[14] The cohort that began junior high school on April 1, 1987 was born between April 2, 1974 and April 1, 1975. Similarly, the cohort that began junior high school on April 1, 1993 was born between April 2, 1980 and April 1, 1981.

[15] In contrast with the after-coding method whereby the respondent details his or her time use over a single day in nominal terms (that is, not following categories or time ranges) that is commonly used in other countries such as

time segments of 15 minutes each[16] and offers 20 possible activities.[17] For each 15-minute time segment, the respondent selects the most appropriate of the twenty pre-printed activities, with individuals engaged in more than one activity at the same time instructed to report the primary activity. Our analysis focuses on home-production time, defined as daily time spent (in minutes) by the husband (or the wife) in any of the following five activities: housework,[18] childcare, caregiving to sick children or the elderly, grocery shopping, and travel time for home production (excluding commuting time to and from school or work). In addition, we also estimate the share of time the husband (or the wife) spends on the couple's total daily time spent in home production. Furthermore, we present heterogeneity analysis by classifying home-production time into the following three categories: housework, childcare, and "other" activities (the remaining three categories of the original five, which were aggregated because time devoted to these was relatively small).[19]

As of October 20, 2016, JTUS also collects socio-demographic individual characteristics for every household member over 10 years old. These include information on age, sex, marital status, number of children, relationship to household head, education, employment and self-employment status, usual weekly work hours, full-time versus part-time status, regular versus non-regular work, and annual income. While regular jobs allow workers to progress within the firm, have salary promotions, job benefits, and job security until retirement, non-regular jobs are temporary or part-time jobs with low salaries and no benefits. The annual income is taxable labor income from the previous year (from October 20, 2015 to October 19, 2016 for the 2016 JTUS).

Finally, in order to explore whether the reform affected gender norms, we conducted our own survey on a representative sample of 31,500 married men and women born between April 1973 and March

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the US, the simplicity and efficiency of the pre-coding method allows for considerably larger samples. For example, the 2016 JTUS interviews 76,553 households whereas the American Time Survey interviews 26,400 households.

[16] Such as 0:00-0:15, 0:15-0:30, … 23:45-24:00.

[17] The twenty activity categories are: 1) sleep, 2) personal up-keep, 3) meals, 4) commuting to and from school or work, 5) work, 6) school, 7) housework, 8) caregiving to the elderly/sick children, 9) childcare, 10) shopping, 11) transportation (excluding commuting to and from school to work), 12) TV, radio, newspaper, and magazine, 13) rest and relaxation, 14) job training, 15) hobby, 16) sports, 17) volunteering and social services, 18) associations, 19) healthcare, and 20) other.

[18] Housework includes many chores: cooking, washing dishes, cleaning, taking out the trash, doing laundry, ironing, sewing, bed making, folding clothes, doing household accounts, managing the household's asset, weeding, doing banking or errands at city hall, car care, and furniture repair.

[19] The majority of time spent in "other activities" is grocery shopping—74.1% for men and 59.6% for women.

1982 and hence from the same cohorts as in our main analysis.[20] We asked them whether they agreed or disagreed with statements such as "the husband should work outside and the wife should protect the family" or "if the husband has enough income, the wife should not have a job."

Sample Restriction

We restrict our analysis to married individuals who filled the time-use diary for at least one of the two days. We focus on married individuals, as we are mostly interested in observing whether the 1990 implementation of junior high school education reform had an impact in the long run on those students' home-production time use within the household.[21] Given our identification strategy, we further restrict our sample to couples in which at least one of the spouses was born within the window of three years before or after April 1977. In other words, we include all individuals born between academic years 1974 and 1979, regardless of whether their spouse was born within those same cohorts.

The 2016 JTUS has information on 350,744 days, 166,429 of which were reported by men (62,895 weekdays and 103,534 weekends). Restricting the sample to men born between school years 1974 and 1979 leaves us with 5,981 weekdays and 10,001 weekends. Further restricting the sample to those who are married and whose information on home production time is not missing leaves us with 3,564 weekdays and 6,371 weekends. A similar exercise leaves us with 4,589 weekdays and 7,712 weekends reported by women.[22] These are the samples used for the time-use analysis.

To analyze labor market outcomes and fertility, we use the 2016 JTUS information at the individual level. Restricting the sample to individuals born between academic years 1974 and 1979 leaves us with 8,037 men and 8,399 women. Further restricting the sample to married individual with non-missing labor market outcomes leaves us with 5,393 men and 6,251 women.

[20] The survey, conducted from July 22-27, 2019, was outsourced to Rakuten Insight, Inc. The sample size of each gender cohort is 1,750. The survey asked socio-demographic individual characteristics and attitudes toward traditional gender roles.

[21] In Japan, a household usually consists of a married man and woman because cohabitation outside of marriage is uncommon, ranging from less than 1% of respondents in 1987 to close to 2% in 2005 based on the *Japanese National Fertility Survey* conducted by the National Institute of Population and Social Security Research.

[22] Of the 184,315 days reported by women in the 2016 JTUS, 69,697 are weekdays and 114,618 weekends. Restricting the sample to those born between school years 1974 and 1979 leaves us with 6,272 weekdays and 10,454 weekends.

Descriptive Statistics

Table 1 presents descriptive statistics of the time Japanese married men and women spent on home production on weekdays and weekends in 2016. Estimates are shown separately for the 1974 to 1976 (pre-reform) and the 1977 to 1979 (post-reform) cohorts. We observe a large gender disparity in home production as Japanese women in the pre-reform cohorts spent on average close to six hours per day in home production during weekdays, close to ten times more than the amount spent by their male counterparts (37 minutes per day). While this gender gap is reduced during weekends, women still spent 3.4 times more on home production than men—5 hours and 54 minutes versus 1 hour and 46 minutes.

Comparing the change in home-production time across pre- and post-reform cohorts, the 25 percent increase observed among men over the weekend is about four times larger than the 8 percent increase observed among women, suggesting a differentiated change in growth rates across genders after the reform. We also observe a 16 percent increase in men's share of home production on weekends but a mild 1.6 percent decrease in women's.

Next, a similar gender disparity is observed in the amount of time spent on work-related activities including working, commuting to and from work, and job training, with pre-reform men spending on average about 10 hours (610 minutes) per day during weekdays, double the amount spent by women on weekdays (301.7 minutes), shown in Appendix Table A1. On weekends, men spent, on average, about 4 hours per day working, three times the amount spent by women. Similarly, Table 2 underscores significant gender differences in labor market characteristics across Japanese married men and women. While most pre-reform men (82%) work in regular jobs, pre-reform women are more likely to work in non-regular jobs (45%) followed by regular jobs (25%) or not employed (23%). Not surprisingly, the gender gap in annual employment income is large, with women earning 63% lower annual labor earnings than men.[23] Comparing the change in women's regular and non-regular jobs across pre- and post-reform cohorts, we observe a two percentage point increase in regular jobs, and a seven percentage point decrease in non-regular jobs.

Finally, Table 2 also shows that 89% of pre-reform married men and 87% of pre-reform married women have children, 2.5 and 2.6 children on average, with 57% of men and 51% of women having young children under 10 years old. Children of post-reform cohorts are fewer but younger.

[23] Based on annual male and female earnings in Table 2, we estimate the gender gap to be 63% = (509.8-191.4)/509.8*100.

Manipulation of Running Variable Test

It is important for our identification assumption that the assignment to treatment around the threshold is random and that the density of the running variable does not jump around the cutoff. A priori manipulation of the running variable (time of birth) is very unlikely because these individuals were born between 1974 and 1979, more than a decade before the policy change was announced in 1989. Indeed, the distribution of the running variable using the 2015 *Japanese National Census* reveals no discontinuity whatsoever at 1977 for either males or females born between 1972 and 1982 (shown in Appendix Figure A2).[24] Moreover, advancing or holding back students a grade is rare in Japan as explained in Section 2.1 above, so we do not need to worry about parents strategically placing their children in different grades.

Even though there is no manipulation of the running variable, a related concern would be a jump in the density of the running variable in our sample of respondents. Figure 1 shows the distribution of the running variable separately for the respondents in our samples of (1) weekday and (2) weekend time-use and (3) labor market outcomes by gender. Among all three samples for women and the weekday sample for men, there is little indication of a discontinuity near the cut-off point. Indeed, the density appears generally quite smooth around the threshold, suggesting that individuals (or their parents) did not manipulate their date of entry into junior high school. While this may be less clear for the weekend time-use and labor market outcome samples for men, the 95% confidence interval of the Cattaneo, Jansson, and Ma (2019) manipulation test of the running variable does not indicate a discontinuity at the cut-off point. Moreover, as we could not reject the null hypothesis that the density of units is continuous near the cut-off point in either of the data subsets, it is safe to assume that assignment to treatment near the threshold is essentially randomized.

Because we focus on married individuals, another potential concern is that there may be a discontinuity in the marriage rate at the 1977 cut-off point. Appendix Figure A3 shows the marriage rate by birth cohort separately for men and women in our sample using both the Census data and our JTUS sample. Appendix Figure A3 shows a similar declining trend in the marriage rate across both datasets, with younger cohorts less likely to be married than older ones. Importantly, we do not observe a discontinuity in the marriage rate at the 1977 cut-off point among men or women. Moreover, we also do not observe any statistically significant discontinuity at the 1977 cut-off point when estimating a 3-year bandwidth RD model with prefecture and day of the week dummy variables and a marriage status indicator as the left-

[24] *The Japanese National Census* has only information on calendar year, not school year. We observe a declining fertility rate over time, but no jump at or around 1977.

hand-side variable for the sample of all men and women in the 2016 JTUS data set.[25] The lack of discontinuity in the marriage rate around the cut-off point indicates that the junior high-school reform did not have an impact on the marriage rate of men and women.

Endogenous Sorting Test

The validity of the RD design also depends on the non-existence of any endogenous sorting. To explore the validity of this assumption, we examine whether individuals' socio-demographic characteristics are balanced (meaning they have equal conditional expectations) around the cut-off point. Evidence of no discontinuity among observable covariates around the cutoff would suggest that discontinuity among unobservable characteristics is less likely. These tests (shown in Table 3) reveal that, for men, two of our six coefficients are statistically significantly different from zero at the 10% level, which is more than what we would expect by chance, but none are statistically significantly different from zero at the 5% level, which is less than what we would expect by chance. For women, none of our coefficients are statistically significantly different from zero.

Table 3 also shows the means for the different socio-demographic characteristics of pre-reform men and women. On average, these individuals are close to 41 years old, have almost 14 years of education (with men slightly more educated than women), and live in 4-person households. In addition, three fifths of these individuals live in high minimum wage prefectures.[26] Women in our sample are married to men who are, on average, 2.5 years older than them, and men are married to women who are one year younger than them.

5. Main Findings

Figure 2A plots the evolution of weekday and weekend home-production time spent by men (panel a) and women (panel b) from cohorts 1972 to 1982 following the procedure of Calonico, Cattaneo, and Titiunik (2015, 2014).[27] The horizontal axis shows the running variable (time), centered on April 1977 which is

[25] The coefficient on β is 0.011 (standard error is 0.012).

[26] Each Japanese prefecture sets its own minimum wage (MW). We classified prefectures with high MW as those 23 prefectures whose MW were above the median. These include Tokyo and Osaka.

[27] The dots represent the local sample means over non-overlapping bins under evenly spaced partitions. The number of bins is selected according to the mimicking variance method which is explicitly tailored to

highlighted by a vertical line. After this date, which is normalized at zero, cohorts were treated with three years of co-educational industrial arts and home economics (IA-HE) instruction during junior high school. To gauge the importance of the discontinuity, the solid line is a second-order polynomial regression curve estimated to flexibly approximate the population conditional mean functions for the control and treated units.

Figure 2A reveals a sharp upturn (of 20 minutes) in the amount of weekend time treated men spend in home production, but no effect on weekdays. The jump is less clear among women but, if anything, indicates a decrease in home-production weekend time after the reform. This is preliminary evidence that the junior high school reform may have had an effect on weekend home production among men at the cut-off point. Figure 2B plots the evolution of men's share of the couples' weekday and weekend time spent in home production. Consistent with Figure 2A, it shows a jump in the treated men's share of household home production during the weekends relative to the pre-reform cohort males, suggesting that the reform affected intra-household distribution of home-production time.

To explore whether the education reform has modified Japanese married couples' distribution of home-production time, Table 4 presents estimates of our RD model described in Section 3 using different specifications. Panel A presents results for males and panel B presents results for females. In the first two rows of Table 4, we use as left-hand-side (LHS) variables the weekday time spent in home production in minutes and as a share of the couple's total time spent in home production, respectively. The next two rows present similar estimates using weekend home-production time and share as LHS variables.

Column 1 in Table 4 presents estimates from our baseline and preferred RD model that controls only for prefecture and day-of-week fixed effects. Among men, we observe that the coefficient of interest, which captures the causal effect of the junior high-school reform on the outcome variable of married individuals is positive and statistically significant at the 5% level or higher for: (1) the share of the couples' weekday time spent in home production, (2) weekend home-production time, and (3) the share of the couples' weekend time spent in home production. In contrast, β is negative and statistically significant at the 5% level for women's weekend time and the share of the couples' weekend time spent in home production, suggesting that the education reform closed the weekend gender gap in home production.

The economic interpretation of the estimates is that the junior high school education reform increased the weekend home-production time of males by 20 minutes per day (the equivalent of an 18% increase from the pre-reform average of 1 hour and 47 minutes) and the male share of the couple's weekend home-production time by 2.4 percentage points, or a 13% increase from the pre-reform average of 18.7%.

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approximate the underlying variability of the raw data and is thereby useful in depicting the data in a disciplined and objective way.

At the same time, the reform reduced the time women spent in home production by 16 minutes (a 5% decrease from the pre-reform average) and their share of the couple's weekend home-production time by 1.3 percentage points (or 1.6%).

Column 2 adds to the column 1 specification controls for an individual's years of education and whether he or she lives in a three-generation household, characteristics which are potentially endogenous.[28] Importantly, adding them does not change the main finding for men. For women, only the reduction in the share of the couples' weekend home-production time remains statistically significant at the 1 percent level. Potential concerns that our findings may be driven by a higher presence of young children in the household are addressed in column 3, which adds to the specification in column 2 the number of young children in the household and an indicator for whether there are children under ten years old. While adding these controls changes slightly the size of some of the β coefficients, overall the main results hold, suggesting that they are not driven by the presence or number of young children in the household.

Weekend Home-Production Time Use by Type

To disentangle what type of activity is driving men's increase in weekend home-production, Figure 3 plots the evolution of men's weekend home-production time by type of activity. It reveals that the upturn is driven by time spent on childcare and other housework, which includes grocery shopping, caregiving to sick children and the elderly, and travel time for home production. For completeness sake, Appendix Figure A.4 shows the evolution of women's weekend home-production time by type of activity.

Panel A in Table 5 presents estimates of our baseline specification using as LHS variables time spent in different types of weekend home-production activities by treated males (row 1) and treated females (row 3). Rows 2 and 4 show a similar analysis with the wives of treated males (row 2) and the husbands of treated females (row 4). Note that in this case, we use as the running variable the husbands' date of birth in row 2 and the wives' date of birth in row 4. The different types of home production are housework (column 1), childcare (column 2) and other (column 3).

Focusing on men first, we observe that those affected by the reform increased their weekend time spent taking care of children by 14 minutes and doing other activities by 12 minutes, and reduced their time on housework by 6 minutes. Meanwhile, their wives decreased their weekend time spent on housework by 14

[28] Ichino and Sanz de Galdeano (2005) argue that the presence of grandparents in the household plays an important role in determining how much time parents spend with their children in childcare. In our sample, 15% and 17% of our pre-reform men and women live in a three-generation household, respectively. These averages are statistically significantly higher by 1.8 and 3.2 percentage points for post-reform men and women.

minutes and other home-production activities by 14 minutes (shown in row 2). All these estimates are statistically significant at least at the 5% level. At the same time, row 3 shows that the reform reduced by 5 minutes the weekend time treated women spent doing other home-production activities at the expense of their husbands, who increased such time by 15 minutes (shown in row 4). Hence, perhaps not surprisingly, we observe that an externality of the reform was to also impact the weekend home-production time of the spouses, independently of whether they themselves were directly affected by the reform or not.[29]

Weekend Non-Home-Production Activities

Table 4 revealed that the junior high-school reform had a long-term impact on the household distribution of time during the weekends, as men increased their home-production time by 20 minutes and women decreased it by 16 minutes. Similarly, Panel A in Table 5 revealed that the husbands of treated women increased their weekend home-production time by 18 minutes while the wives of treated men decreased their home-production time by 8 minutes. Consequently, one may wonder what weekend activities were crowded out by the increase in men's home-production time? Conversely, one may ask what weekend activities expanded as women reduced their home-production time?

To address these questions, Panel B in Table 5 shows the effect of the education reform on weekend time spent in activities other than home-production, namely leisure (column 4), life support (column 5) and (paid) work-related activities (column 6). Leisure activities include watching TV, listening to the radio, reading the newspaper or magazines, resting and relaxing, doing hobbies or sports, volunteering and participating in social services or associations. Life-support activities include activities involving personal care, eating and sleeping, and work-related activities include working, commuting to and from work, and job training. As in Panel A, the estimates are obtained using our baseline specification and are shown for treated males and females (rows 1 and 3) and their spouses (rows 2 and 4).

We find that the reform reduced the gender gap in time spent in work-related activities on the weekend. This is illustrated by Figure 4, which plots the evolution of weekend time in work-related activities for men and women. The plots for weekend time spent in the different types of non-home-production activities are shown in Appendix Figures A5 and A6. As the junior high-school reform reduced treated men's weekend time in work-related activities by 30 minutes and increased women's weekend time

[29] As women in Japan marry older men on average, their spouses are less likely to have been affected by the reform during junior high school. The opposite is true for treated men and their spouses. Nonetheless, rows 2 and 4 estimate the effect of the reform on the spouses, regardless of whether or not they were directly affected by the reform.

in work-related activities by 13 minutes, this gender gap was reduced by 43 minutes. Interestingly, treated women also reduced their weekend time spent in leisure activities by 7 minutes. Both treated men and women increased their time in life-support activities by 9 minutes.

Labor Market Outcomes

The evidence thus far indicates that the implementation of the junior high-school reform closed the gender gaps in weekend home-production time and time spent in (paid) work-related activities by increasing men's engagement in traditionally female activities (home-production) and decreasing men's engagement in traditionally male activities (time spent in work-related activities), and the opposite for women. We also observe a small effect of the reform on the gender gap in the weekend share of home production, as the reform increased the male share but had no effect on female home-production time. We now proceed to analyze the impact of the reform on the labor market outcomes of married women. To explore this, Figure 5 plots the evolution of different labor market outcomes for Japanese married women such as the share of women working in regular and non-regular jobs, being self-employed or out of work, working in high-wage occupations[30], and annual wage and salary income. At the cut-off point, we observe a discontinuity in the share of regular and non-regular work and in annual wage and salary income. Appendix Figure A7 shows similar plots as in Figure 5 for married men. To gauge the causal effect of the reform on these outcomes, Table 6 presents estimates of our baseline specification using as LHS variables married women's labor market outcomes, namely, time spent working on weekdays, the likelihood of working in a regular job or a non-regular job, being self-employed and not working, and annual employment income.[31] The analysis is performed separately for treated males and females (rows 1 and 2). Focusing first on treated women, we observe that the reform increased women's likelihood to work in a regular job by 5 percentage points and decreased their likelihood to work in a non-regular job by 6 percentage points. This represents a 19% increase in the likelihood of

[30] A high-wage occupation dummy variable takes a value of 1 if the average occupation wage is higher than the overall average and 0 otherwise. High-wage occupations include managers, professionals and engineers, clerical workers, security workers, manufacturing workers, transports and machine operation workers, and workers in construction and mining. Low-wage occupations include sales, services, agriculture, forestry and fishery, cleaning and packaging.

[31] A respondent is required to select an income range such as less than 500,000 yen, 500,000-999,999 yen, and so on. We used the median of each category. If a respondent does not work, we set the income to 0.

working in a regular job and a 12% decrease in the likelihood of working in a non-regular job. The reform also increased women's annual earnings by 12%, given average earnings of 1.91 million yen ($17,879, $1=107 yen) for the pre-reform cohorts. As no effect is found on the likelihood of working in high-occupation jobs or at the intensive or extensive margin, this income effect is driven by the higher access to well-paying jobs with benefits (i.e. regular jobs rather than non-regular jobs). It is interesting to observe that the reform had a negligible impact on male labor market outcomes.[32]

6. Sensitivity Analysis and Placebo Tests

Table 7 presents robustness checks and placebo estimates for our main outcome variables, namely men's weekend home-production time, and women's likelihood of working in a regular job, in a non-regular job and annual employment income. Column 1 presents our baseline estimates for comparison purposes. Columns 2 and 3 present estimates using one-year smaller and larger bandwidth, respectively. Columns 4 to 8 present estimates using 5- or 10-year bandwidth and different functional polynomial forms. While we do observe some changes in the size and precision of a few estimates, overall, the findings tell a consistent story by which the reform reduced the gender gaps in weekend home production and in regular and non-regular employment and annual income.

Column 9 addresses concerns that the cohorts closest to the reform year may be contaminated by the gradual implementation of the reform for those students, in which case it may be better to only use cohorts further apart. To address this concern, we estimate a doughnut RD model whereby the 1975 and 1976 cohorts are excluded from the analysis sample, with 1972 to 1974 cohorts now pre-reform and 1977 to 1980 cohorts post-reform. These estimates corroborate the earlier findings, with only the effect on female labor income smaller and no longer statistically significant. Finally, column 10 re-estimates the baseline model using month of birth as the running variable. Overall, the estimates are quite similar to those in column 1, although less precisely estimated because the sample size of each birth month cell becomes very smaller than a birth year cell.[33]

[32] The finding that family policies have a negligible impact of men's labor market outcomes is not uncommon (Farré and González 2019).

[33] For example, regarding the men's weekend sample, the mean sample size of birth year for the 1974-1980 cohorts is 910.1; however, that of birth month is 75.8.

Appendix Table A2 presents non-parametric estimates that calculate the optimal bandwidth by minimizing the mean square error, as explained by Calonico, Cattaneo, and Titiunik (2015). They use the triangular kernel function to estimate the treatment effect, controlling for prefecture and day of week. While we use parametric estimation, these optimal bandwidth estimates are similar in size to those used in our baseline specification.

Because we cannot test selection on unobserved variables around the discontinuity, in columns 11 and 12 in Table 7, we estimate two different placebo tests. Column 11 displays RD estimates using cohorts born before the reform (between 1967 and 1973; three years before and after the placebo cutoff of 1970) and column 12 displays RD estimates using cohorts born after the reform (between 1980 and 1986; the placebo cutoff is 1983). All but one of the placebo estimates are not statistically significant. Moreover, the size of the coefficients is considerably smaller. The only statistically significant coefficient is the wrong sign.

7. Subgroup Analysis

Table 8 presents subgroup analysis by education level (distinguishing between less than college and some college or more), whether the individual lives in a three- or two-generation household, and whether they live in a high-wage prefecture (that is, Tokyo, Kanagawa, Aichi, Osaka) or a low-wage prefecture (the rest of Japan).

Interestingly, while the effect of the reform on married men's weekend home-production time is observed across the board, the reform's reduction on married women's weekend home-production time is driven by low-educated women and those living in low-wage prefectures. In contrast, the effects of the reform on the labor market seem to benefit the most highly-educated women, those living in three-generation households or in low-wage prefectures. Further, the reduction in the gender labor income gap is widespread across all groups, which might be driven by reduction in non-regular employment.

7. Fertility and Gender Norms

Fertility

The evidence thus far indicates that the junior high-school reform that abolished gender segregation and stereotyping of IA-HE education reduced the gender gaps in weekend intra-

household home production and in the labor market via regular versus irregular jobs and income. With the stronger labor market attachment of wives and the change in the allocation of childcare duties between spouses, with fathers increasing their involvement in childcare, it is possible that the reform also affected the desired number of children and fertility outcomes. Indeed, Feyrer et al. (2008), Doepke and Kindermann (2016) and Farré and González (2019) find that the distribution of the childcare burden between mothers and fathers is an important determinant of fertility. Stronger female labor attachment may have increased the opportunity costs of having children. Alternatively, higher father involvement in childcare may have increased their awareness of the full costs of having children or shifted their preferences in favor of child quality (versus quantity).

Figure 7 and Table 9 analyze the effect of the junior high-school reform on fertility by using two different outcomes: the total number of children and of young children (under 10 years old) at the time of the survey. Interestingly, we observe that men affected by the reform have fewer children overall by 2016 but more young children, suggesting that they delayed fertility. This is consistent with Farré and González (2019). As we did not find that the reform increased labor market attachment of their wives,[34] the delay in fertility among men must be the result of their increased awareness of the full costs of having children or a change in their preferences in favor of child quality. In contrast, we find no effect of the reform on the fertility of affected women, which is perhaps not surprising as we did not find that the reform had an indirect effect on their spouse's childcare (even though it did increase their caregiving for sick children and for the elderly, grocery shopping, and travel time for home production)—shown in Table 5.

Gender Attitudes

A potential mechanism is that the reform affected men's and women's beliefs on gender roles. Figure 7 and the last column in Table 9 explore whether the reform altered the share of married men and women who disagree with either of these two statements: "the husband should work outside and the wife should protect the family" or "if the husband has enough income, the wife should not have a job." The gender norm variable takes 1 if the respondent disagrees or somewhat disagrees with either statement above, and 0 otherwise. While there is no evidence of an effect on

[34] Result not shown but available from authors upon request.

married men's beliefs on gender roles, Figure 8 and Table 9 reveal an increase in the likelihood that married women will disagree with traditional gender roles, suggesting that for women a potential mechanism of this education reform is through changes in their gender norms, consistent with Rodríguez-Planas and Tanaka (2018). The fact that we find no effects of the reform on male gender norms, even though the reform increased their weekend home-production time, suggests that the mechanism for men may well be through their wives' gender norms.

7. Conclusion

Using Regression Discontinuity design and Japanese time-use data from 2016, we analyze whether the introduction of the junior high school education reform on April 1, 1990 caused a behavioral change among students affected by this reform more than two decades later, when they were married and in their late thirties/early forties. Among the behavioral changes we study are: time spent by men and women in home production during weekdays and weekends, their preferences for children (measured by number of children born by 2016), and their labor market outcomes—measured by time spent on work-related activity, type of employment and labor income. The analysis is done separately for men and women, and evidence that the junior high-school reform affected the behavior of married men and women in their late thirties/early forties suggest that this education reform, which mainly eliminated segregated and gender-stereotyped industrial arts and home economics (IA-HE) in junior high school, was successful in modifying treated individuals' long-term behavior.

We find robust evidence that the implementation of the junior high school reform closed the gender gaps in weekend home-production time and weekend time spent in work-related activities by increasing men's engagement in traditionally female activities (home-production) and decreasing men's engagement in traditionally male activities (time spend in work-related activities), and the opposite for women. We also find that the reform reduced the gender gap in regular employment and labor annual earnings, with effects on women driving these results. Finally, the evidence seems to indicate that the reform delayed fertility among men but had no effect on women. Evidence that the reform increased the number of women who disagree with statements such as "the husband should work outside and the wife should protect the family" or "if the husband has enough income, the wife should not have a job" suggests that a mediating

channel may be a change in women's perception of gender norms. These findings are robust to a battery of sensitivity checks as well as placebo tests.

A limitation of the study is that we cannot identify the specific path that might lead to men's change in attitudes towards home production. As home economics classes teach not only content that might raise students' awareness about gender roles but also skills in home production, it is possible that men's participation in home production might have changed due to skill accumulation rather than changes in attitudes, which would be consistent with our lack of findings of the reform on men's gender norms. Future research should focus on identifying the extent to which education reforms can shape attitudes and preferences. Evidence that they do would support educational policies that could modify gender norms and have behavioral consequences towards gender equality.

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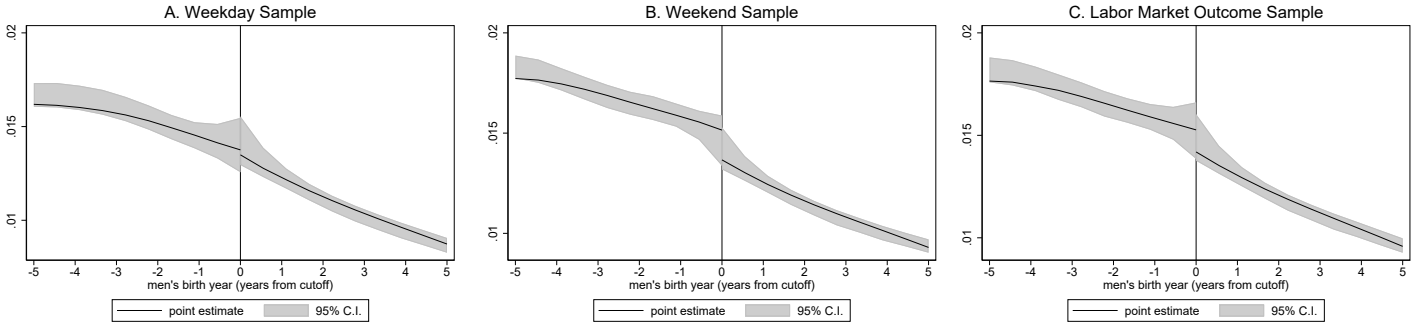
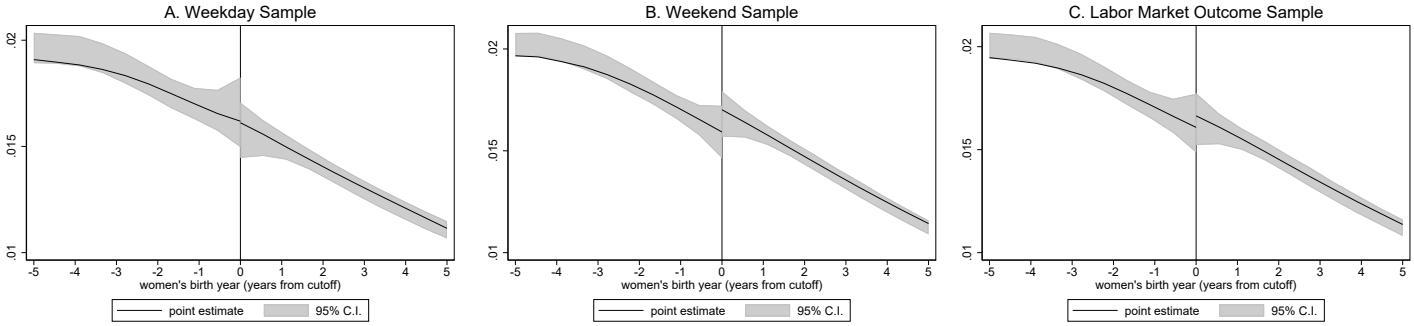
Figure 1: Density of the Forcing Variable by Birth Year across Three Analysis Samples

(a) Men



(b) Women

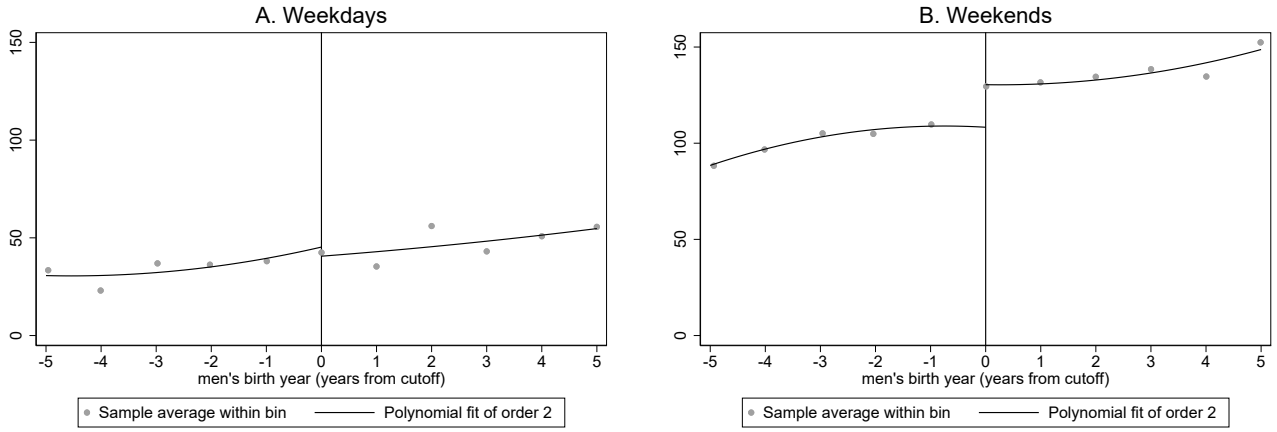


Source: 2016 JTUS.

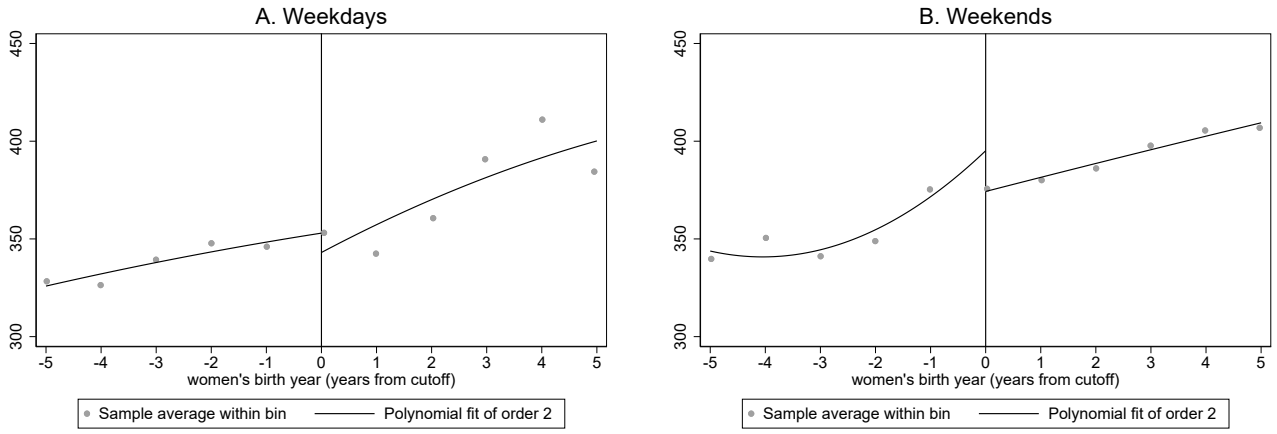
Notes: The graphs show the results of the manipulation test of the forcing variable proposed by Cattaneo, Jansson, and Ma (2019). For all figures, the order of the local polynomials used to construct the point estimator and bias-corrected density point estimator is two and three, respectively, and the kernel function is triangular. The gray zone shows a 95% confidence interval.

Figure 2A: Home Production Time, by Gender

(a) Men

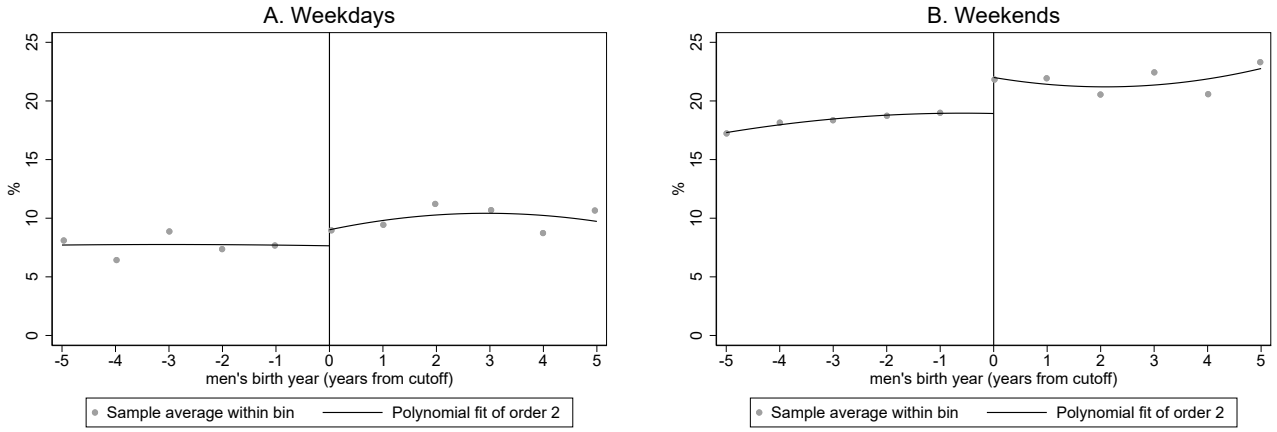


(b) Women



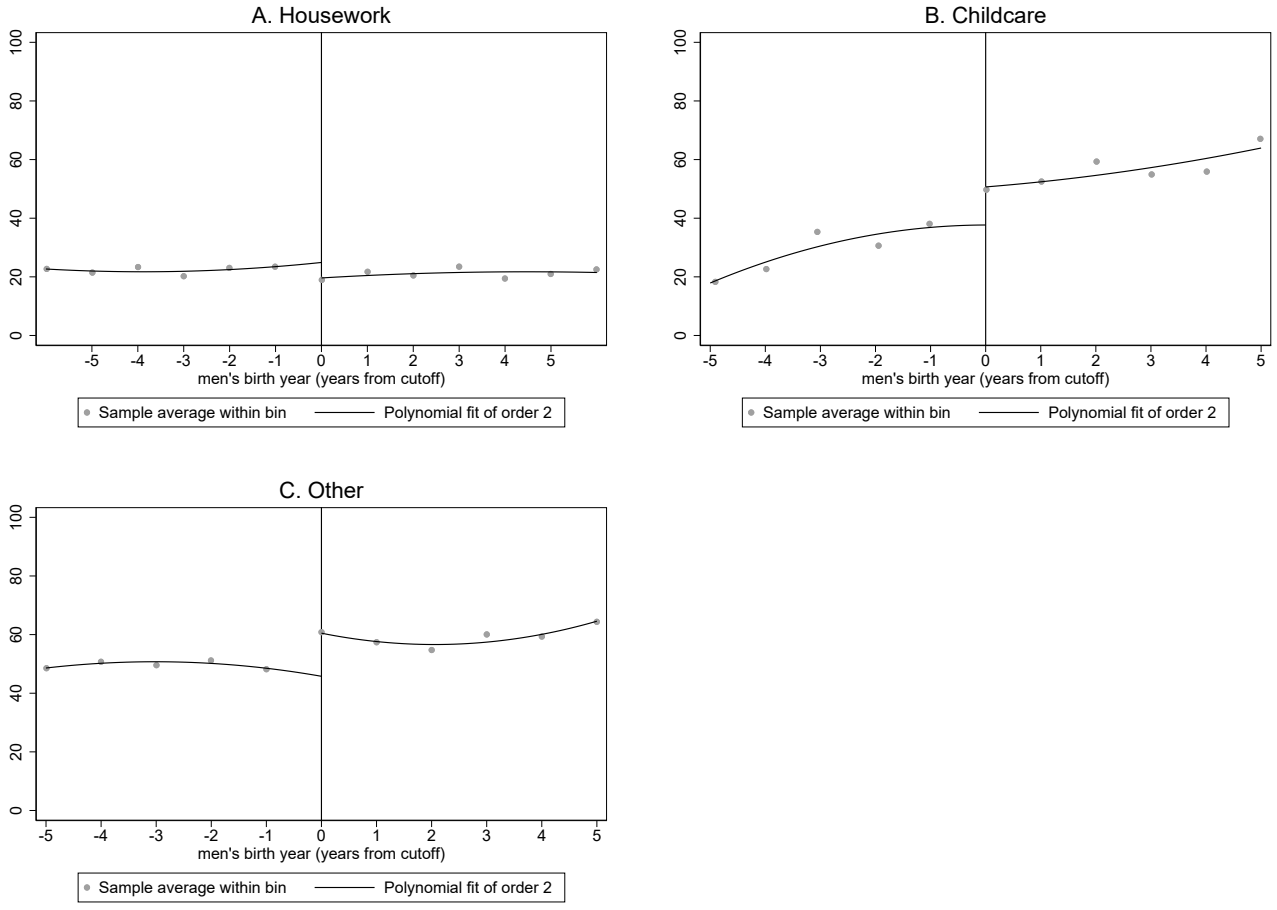
Source: 2016 JTUS.
Notes: The analysis sample consists of 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero.

Figure 2B: Husband's Share of Home Production within A Couple (Couple Sample)



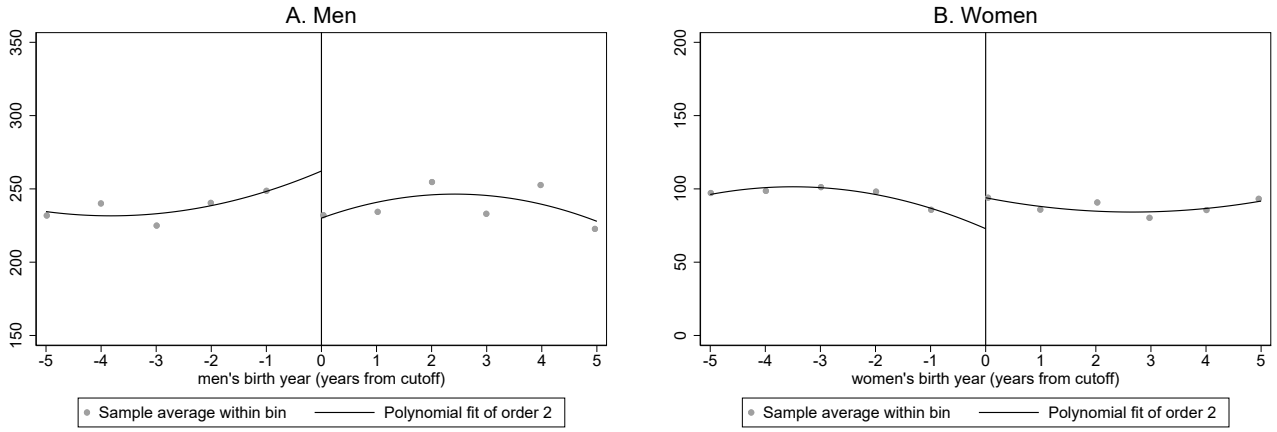
Source: 2016 JTUS.
Notes: The analysis sample consists of 1972-1982 cohorts, for which we observe the spouse. The vertical line is at the threshold date, which is normalized to zero.

Figure 3: Men's Weekend Home Production by Activity Type



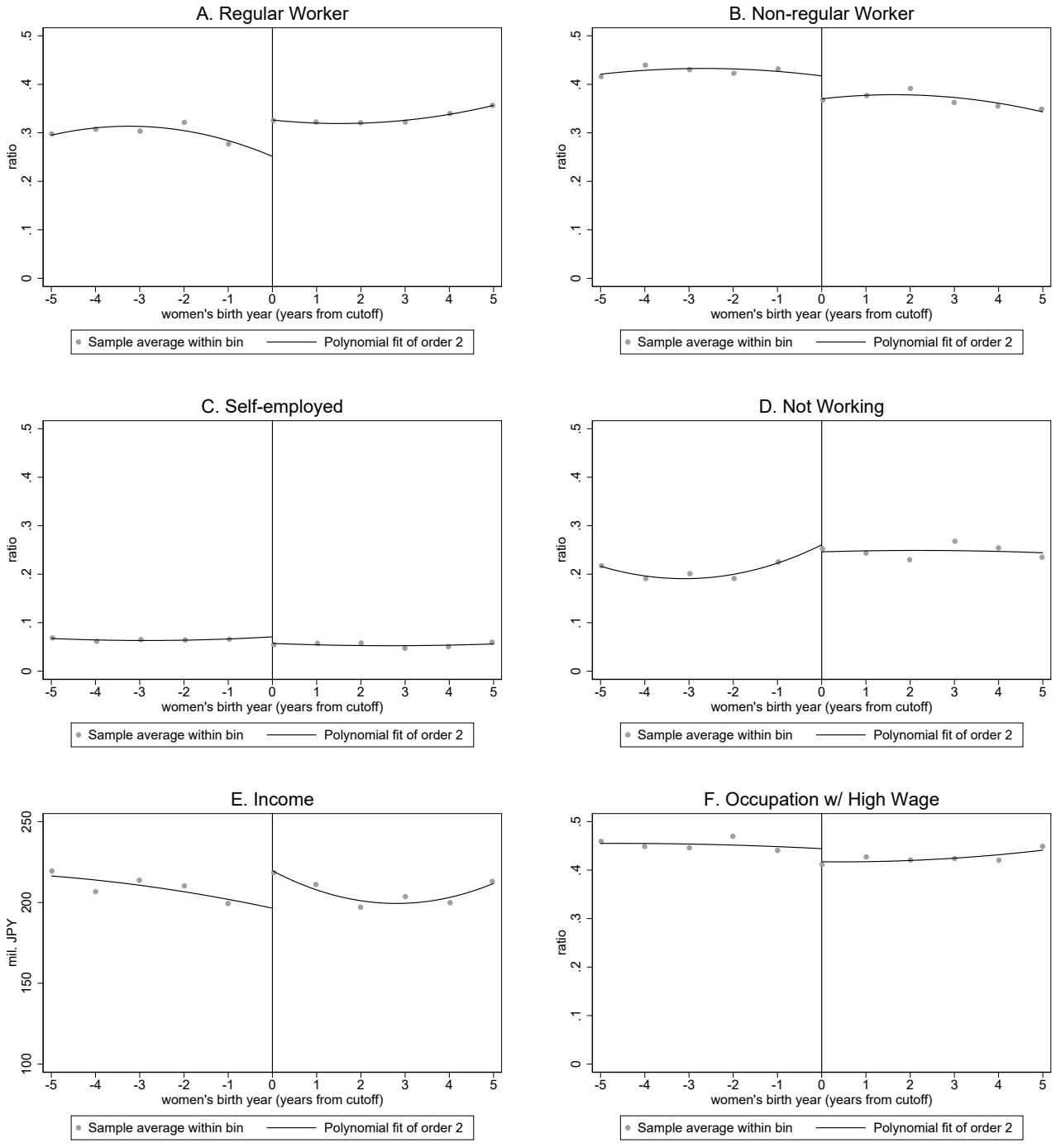
Source: 2016 JTUS.
Notes: The analysis sample consists of 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero.

Figure 4: Weekend Work-Related Activity



Source: 2016 JTUS.
Notes: The analysis sample consists of 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero.

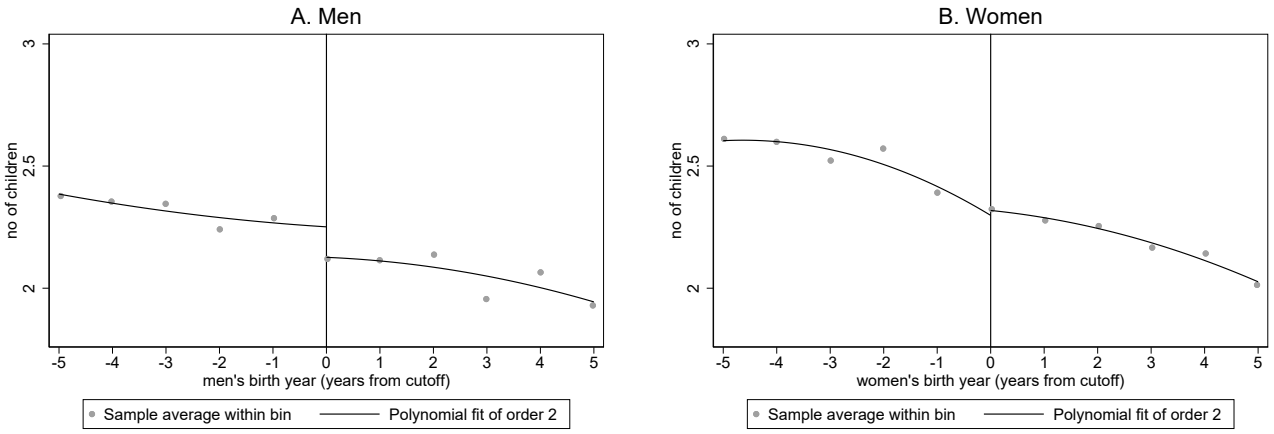
Figure 5: Labor Market Outcome, Women



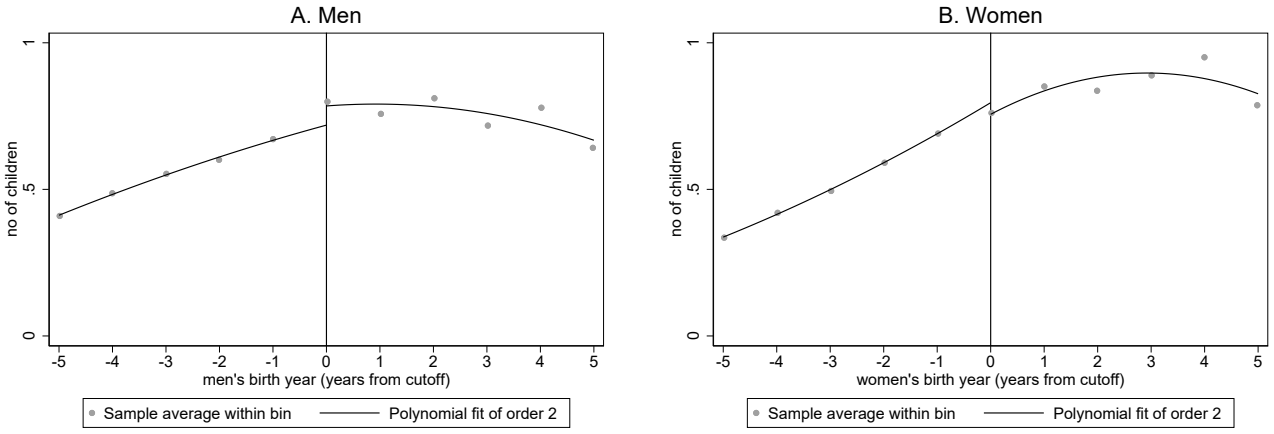
Source: 2016 JTUS.
Notes: The analysis sample consists of 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. Information at the individual level is used.

Figure 6: Total Number of Children and Total Number of Children Under 10 Years Old, by Gender

(a) Total Number of Children

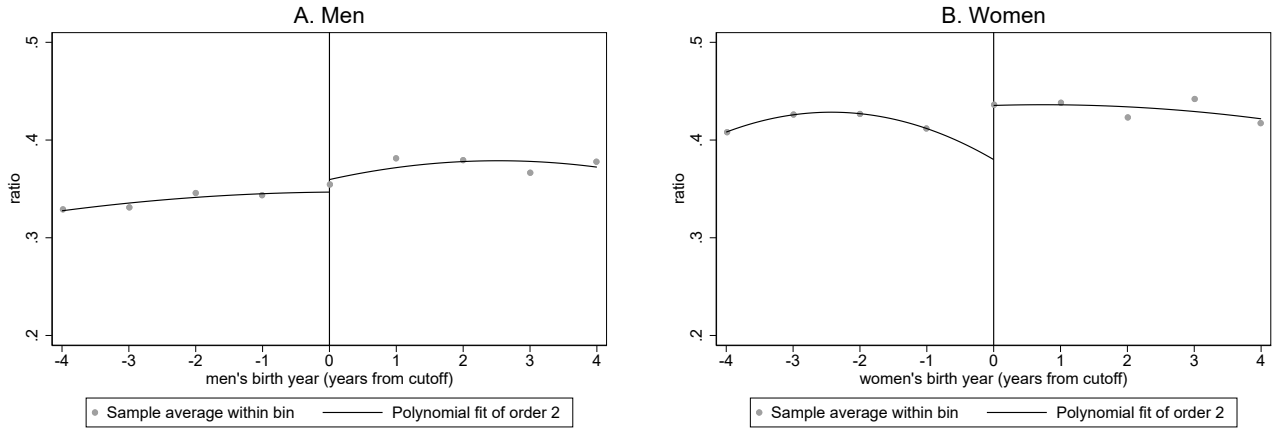


(b) Total Number of Children under 10 Years Old



Source: 2016 JTUS
Notes: The analysis sample consists of 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. Information at the individual level is used.

Figure 7: Disagrees with Traditional Attitudes, by Gender



Source: Original Survey.
Notes: The analysis sample consists of the 1973-1981 cohorts, who were in coeducational classes in junior high school. The vertical line is at the threshold date, which is normalized to zero. "Disagrees with traditional attitudes" indicates that the respondent disagrees or somewhat disagrees to either "the husband should work outside and the wife should protect the family" or "if the husband has enough income, the wife should not have a job."

Table 1: Descriptive Statistics for Home Production
(Averages per Cohort)

	Pre-Reform 1974 to 1976 cohorts	Post-Reform 1977 to 1980 cohorts	Diff	Diff
	Mean (Sd)	Mean (Sd)	Absolute	% change
Men				
Home Production				
Weekdays				
Time (min)	37.09 (95.40)	43.87 (98.16)	+6.8 **	+18%
Share relative to spouse (%)	8.03 (16.7)	9.96(19.4)	+1.9 ***	+24%
Weekends				
Time (min)	106.50 (162.20)	133.20 (171.1)	+26.7 ***	+25%
Share relative to spouse (%)	18.7 (23.6)	21.7 (24.1)	+3.0 ***	+16%
Each Activity on Weekends (min)***:***				
Housework	22.24 (61.07)	20.98 (57.64)	-1.3	-6%
Childcare	34.60 (104.70)	53.77 (123.60)	+19.2 ***	+55%
Other	49.68 (90.95)	58.42 (97.08)	+8.7 ***	+18%
Women				
Home Production				
Weekdays (min)	344.20 (234.80)	361.1 (227.0)	+16.9 **	+5%
Share relative to spouse (%)	92.58 (16.70)	90.87 (17.9)	-1.7 ***	-2%
Weekends (min)	354.30 (222.40)	384.20 (229.30)	+29.9 ***	+8%
Share relative to spouse (%)	81.08 (24.2)	79.5 (23.7)	-1.6 ***	-2%
Each Activity on Weekends (min)***:***				
Housework	194.30 (143.90)	181.40 (141.40)	-12.9 ***	-7%
Childcare	66.59 (139.20)	106.90 (172.20)	+40.3 ***	+61%
Other	93.41 (100.20)	95.93 (106.00)	+2.5	+3%

Source: 2016 JTUS.
Notes: The size of the weekday and weekend time-use samples for men are 3,564 and 6,371, respectively. For women, they are 4,589 and 7,712. These statistics indicate the mean (with standard deviations in parentheses). The symbols ***, **, and * indicate that the pre- post-reform differences are statistically significant at the 1%, 5%, and 10% level, respectively.

Table 2: Descriptive Statistics for Number of Children and Labor Market Outcomes (Averages per Cohort)

	Before 1977 Cohorts 1974 to 1976	After 1977 Cohorts 1977 to 1980	Diff		Diff
	Mean (Sd)	Mean (Sd)	Absolute		% change
Men					
Has children	0.89 (0.32)	0.88 (0.33)	-0.01		-1%
Total number of children	2.50 (1.61)	2.11 (1.41)	-0.39	***	-15%
Has children < 10 years old	0.57 (0.50)	0.69 (0.46)	+0.12	***	+7%
Number of children < 10 years old	0.87 (0.90)	1.17(0.80)	+0.30	***	+34%
Labor Market Outcomes					
Regular worker	0.82 (0.38)	0.84 (0.37)	+0.02		+2%
Non-regular worker	0.03 (0.17)	0.04 (0.19)	+0.01		+24%
Self-employment	0.14 (0.35)	0.12 (0.32)	-0.02	**	-15%
Non-work	0.01 (0.09)	0.01 (0.08)	+0.00		-14%
Annual income (in Yen)	509.80 (234.30)	470.60 (222.40)	-39.20	***	-8%
High-wage occupation	0.66 (0.47)	0.65 (0.48)	-0.01		-1%
Women					
Has children	0.87 (0.33)	0.89 (0.32)	+0.01		+1%
Total number of children	2.60 (1.71)	2.25 (1.47)	-0.35	***	-13%
Has children < 10 years old	0.51 (0.50)	0.66 (0.48)	+0.15	***	+29%
Number of children < 10 years old	0.75 (0.87)	1.10 (0.98)	+0.35	***	+46%
Labor Market Outcomes					
Regular worker	0.25 (0.43)	0.27 (0.44)	+0.02	**	+9%
Non-regular worker	0.45 (0.50)	0.38 (0.49)	-0.07	***	-16%
Self-employment	0.07 (0.25)	0.06 (0.24)	-0.01		-14%
Non-work	0.23 (0.42)	0.29 (0.45)	+0.06	***	+26%
Annual income (in Yen)	191.30 (165.00)	192.60 (157.10)	+1.30		+1%
High-wage occupation	0.432 (0.495)	0.399 (0.490)	-0.03	***	-8%

Source: 2016 JTUS.

Notes: The sample size for fertility and labor market outcomes is 5,393 for men (5,311 for annual income) and 6,251 for women (4,582 for annual income). The unit for annual income is 10,000 Japanese yen ($1 = 107JPY).

These statistics reflect the mean (with standard deviations in parentheses). The symbols ***, **, and * indicate that the pre- post-reform differences are statistically significant at the 1%, 5%, and 10% level, respectively.

Table 3. Balance Tests (Weekend Sample)

	Own age	Own years of education	Household members	Spouse's age	Spouse's years of education	Lives in prefecture with high MW
Men (Forcing variable: Men's date of birth)						
	-0.041*	-0.098	-0.002	-0.029	-0.069*	-0.011
	(0.019)	(0.104)	(0.031)	(0.196)	(0.030)	(0.010)
Means for pre-reform cohort	40.62	13.91	4.08	39.47	13.78	0.59
Sample sizes	6,371	6,296	6,371	5,764	5,722	6,371
Women (Forcing variable: Women's date of birth)						
	0.002	0.001	0.052	-0.048	-0.147	0.002
	(0.027)	(0.052)	(0.049)	(0.161)	(0.089)	(0.007)
Means for pre-reform cohort	40.65	13.73	4.07	43.18	13.94	0.592
Sample sizes	7,712	7,631	7,712	6,546	6,480	7,712

Source: 2016 JTUS.

Notes: Each column represents the coefficient β_0 from a regression using a 3-year bandwidth RD model with prefecture and day of the week dummies. The outcome variables are indicated by the column labels. When the outcome is "lives in prefecture with high minimum wage (MW)" no prefecture dummies are included in the model. Robust standard errors are clustered at the year-of-birth level. Spouse's age and education are calculated with a sample which has his/her spouse; therefore, sample sizes are smaller. Each Japanese prefecture sets its own minimum wage. We classified prefectures with high MW as those 23 prefectures whose MW were above the median. These include Tokyo and Osaka.

Table 4. Home-Production Time

	Spec 1	Spec 2	Spec 3
		Panel A: Men	
Weekdays			
Time (min)	0.437	0.477	-2.271
	(2.727)	(2.809)	(3.210)
Share relative to spouse (%)	1.950**	1.536**	1.382**
	(0.603)	(0.551)	(0.557)
Weekends			
Time (min)	19.653***	24.129***	20.481***
	(1.205)	(3.462)	(2.522)
Share relative to spouse (%)	2.389***	2.362***	2.012***
	(0.298)	(0.233)	(0.259)
		Panel B: Women	
Weekdays			
Time (min)	-10.238	-9.310	-17.852
	(11.609)	(13.193)	(12.900)
Share relative to spouse (%)	-0.831	-0.999	-0.943
	(0.850)	(0.793)	(0.814)
Weekends			
Time (min)	-15.942**	-9.773	-7.226
	(5.426)	(5.973)	(5.861)
Share relative to spouse (%)	-1.293**	-1.319***	-1.003**
	(0.481)	(0.318)	(0.385)
Years of education		X	X
Three-generation household		X	X
Total number of children			X
Number of children under 10			X

Source: 2016 JTUS.

Notes: Estimates are from a 3-year bandwidth RD model with prefecture and day of the week dummies and additional covariates when indicated in the bottom rows of the table. Robust standard errors are clustered at the year-of-birth level. Sample sizes of time are 3,564 for men and 4,589 for women on weekdays and 6,371 for men and 7,712 for women on weekends. Share relative to spouse are estimated using a sample which has his/her own spouse; therefore, sample sizes are 3,289 for men and 3,739 for women on weekdays, and 5,764 for men and 6,546 for women on weekends.

Table 5. Weekend Time Use by Type of Activity (in Minutes)

Panel A: Home Production			*Panel B: Not-Home Production*		
(1)	(2)	(3)	(4)	(5)	(6)
Housework	Childcare	Other	Leisure	Life-Support Activity	Work-Related Activity
Men (Running variable: Men's date of birth)					
-6.058***	13.767***	11.945***	0.592	9.312***	-29.557***
(0.986)	(3.679)	(2.175)	(1.717)	(1.544)	(2.630)
Treated Men's Wives (Running variable: Husbands' date of birth)					
-13.647***	13.392	-8.273**	-3.803	2.423	9.907
(3.222)	(10.167)	(2.542)	(3.611)	(1.881)	(12.608)
Women (Running variable: Women's date of birth)					
-3.581	-7.107	-5.255**	-6.647***	9.352*	13.237***
(5.000)	(4.494)	(1.918)	(1.559)	(4.552)	(3.359)
Treated Women's Husbands (Running variable: Wives' date of birth)					
0.202	2.813	15.081***	-11.223	4.518*	-7.790
(2.562)	(10.114)	(3.942)	(6.924)	(2.162)	(6.834)

Source: 2016 JTUS.

Notes: Estimates are from a 3-year bandwidth RD model with prefecture and day of the week dummies. Robust standard errors are clustered at the year-of-birth level. Sample sizes of time are 6,371 for men and 7,712 for women. Other home production in column 3 includes caregiving for sick children and the elderly, grocery shopping, and travel time for home production (excluding commuting time to and from school or work). Life-support activities in column 5 include personal care, eating and sleeping.

Table 6. Labor Market Outcomes

Weekday time spent working (in minutes)	Regular employment	Non-regular employment	Self-employed	Not working	Annual income	High-wage occupation
Men						
-4.737	-0.006	0.012	-0.001	-0.004	-0.951	0.013
(7.570)	(0.011)	(0.008)	(0.008)	(0.004)	(11.875)	(0.015)
Women						
6.999	0.047**	-0.056***	-0.015*	0.024	23.641***	-0.025
(16.808)	(0.017)	(0.009)	(0.007)	(0.023)	(2.237)	(0.018)

Source: 2016 JTUS.

Notes: Estimates are from a 3-year bandwidth RD model with prefecture and day of the week dummies. Robust standard errors are clustered at the year-of-birth level. The sample for labor-market outcomes is 5,393 for men (5,311 for annual income) and 6,251 for women (4,582 for annual income). The unit for annual income is 10,000 Japanese yen ($1 = 107JPY). Sample sizes of work-related time on weekdays are 3,564 for men and 4,589 for women.

Table 7. Sensitivity Analysis of Main Findings

	Baseline	Bandwidth = 2 years	Bandwidth = 4 years	Bandwidth = 5 years		Bandwidth = 10 years			Bandwidth = 3 years	Bandwidth = 36 months	Placebo	
				Lineal	*2nd polynomial*	*Lineal*	*2nd polynomial*	*3rd polynomial*	*Doughnut*		*Pre (1967-73)*	*Post (1980-86)*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Men's weekends home production (min)	19.653**	17.959***	16.944***	12.145***	23.573***	19.340*	9.266**	18.371***	16.547***	18.571	-5.142	-1.485
	(1.205)	(0.731)	(2.754)	(2.754)	(2.548)	(2.813)	(4.254)	(3.812)	(1.047)	(12.537)	(5.075)	(8.673)
Women's regular employment	0.047**	0.079***	0.034	0.027	0.062***	0.020*	0.026	0.044**	0.019**	0.030	-0.011	-0.019
	(0.017)	(0.008)	(0.020)	(0.017)	(0.018)	(0.011)	(0.019)	(0.021)	(0.007)	(0.027)	(0.002)	(0.015)
Women's non-regular employment	-0.056***	-0.084***	-0.047***	-0.69***	-0.034	-0.065***	-0.051***	-0.060***	-0.091***	-0.052*	0.009	-0.012
	(0.009)	(0.004)	(0.012)	(0.013)	(0.022)	(0.011)	(0.016)	(0.019)	(0.020)	(0.027)	(0.015)	(0.023)
Women's annual income	23.641**	20.998**	16.414***	14.297**	23.433***	6.035	16.149***	21.661***	7.518	20.770**	-14.124*	-4.742
	(2.237)	(3.592)	(3.570)	(5.389)	(6.102)	(6.126)	(5.250)	(6.322)	(4.818)	(9.238)	(5.788)	(10.949)

Source: 2016 JTUS.

Notes: Column 1 presents our baseline estimates for comparison purposes. Columns 2 and 3 present estimates using one-year smaller and larger bandwidths, respectively. Columns 4 to 8 present estimates using 5- or 10-year bandwidths and different functional polynomial forms. In column 9, the cohorts from 1972 to 1974 are used as the pre-reform cohorts and the cohorts from 1977 to 1980 are used as the post-reform. Column 10 re-estimates the baseline model using months as a running variable. Column 11 displays RD estimates using cohorts born before the reform (between 1968 and 1974) and Column 12 displays RD estimates using cohorts born after the reform (between 1980 and 1986).

Table 8. Subgroup Analysis

	Low Educated	High Educated	Three-generation households	Two-generation households	High-Wage prefectures	Low-Wage prefectures
	1	*2*	*3*	*4*	*5*	*6*
Men's weekend home production (min)	25.244**	15.382	47.850	23.750***	26.103**	18.482***
	(7.549)	(11.003)	(27.051)	(1.255)	(7.778)	(1.058)
Women's weekend home production (min)	-34.918***	7.948	25.371	-13.770	-24.109	-14.868***
	(8.287)	(5.046)	(22.246)	(9.365)	(24.414)	(3.919)
Women's regular employment	0.054	0.038**	0.123*	0.029*	-0.0004	0.051**
	(0.031)	(0.014)	(0.059)	(0.015)	(0.027)	(0.016)
Women's non-regular employment	-0.055**	-0.074***	-0.196**	-0.031***	-0.049	-0.055***
	(0.020)	(0.006)	(0.078)	(0.006)	(0.029)	(0.012)
Women's annual income	12.420*	45.163***	39.620***	21.548***	18.381***	23.295***
	(5.525)	(7.554)	(9.621)	(3.959)	(3.216)	(2.651)

Source: 2016 JTUS.

Notes: Estimates are from a 3-year bandwidth RD model with prefecture and day of the week dummies. Robust standard errors are clustered at the year-of-birth level. Low-education level includes individuals whose highest educational attainment is junior high school, high school or vocational training. High-education level includes individuals with a 2-year college degree or higher. High-wage prefectures include Tokyo, Kanagawa, Aichi, and Osaka.

Table 9. Children and Gender Norms, by Gender

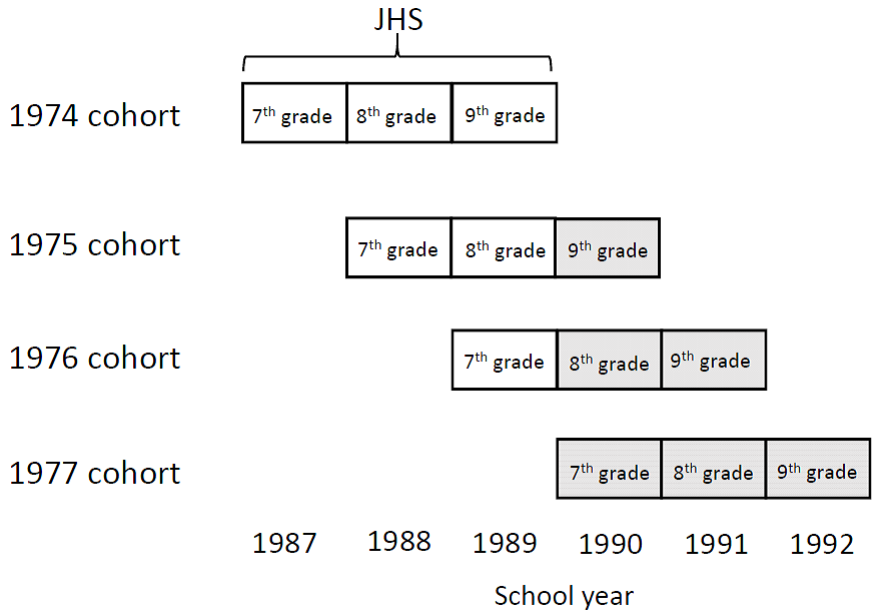
All children		Children under 10 years old		Disagrees with Traditional Norms
Has Children	Total Number	Has Children	Total Number	
Men				
-0.010	-0.177***	0.007	0.075***	0.013
(0.007)	(0.024)	(0.006)	(0.018)	(0.011)
Women				
0.003	-0.060	-0.013**	0.008	0.031***
(0.003)	(0.090)	(0.004)	(0.008)	(0.006)

Source: All children and children under 10 years old: 2016 JTUS. Gender Norms: Authors' own survey.

Notes: Estimates are from a 3-year bandwidth RD model with prefecture and day of the week dummies. Robust standard errors are clustered at the year-of-birth level. Sample sizes of all estimations of all children and children under 10 years old are 5,410 for men and 6,256 for women. Sample sizes of "disagrees with traditional norms" are 11,215 for men and 11,161 for women, and the analysis samples are restricted to those who were in co-educational classes in middle school.

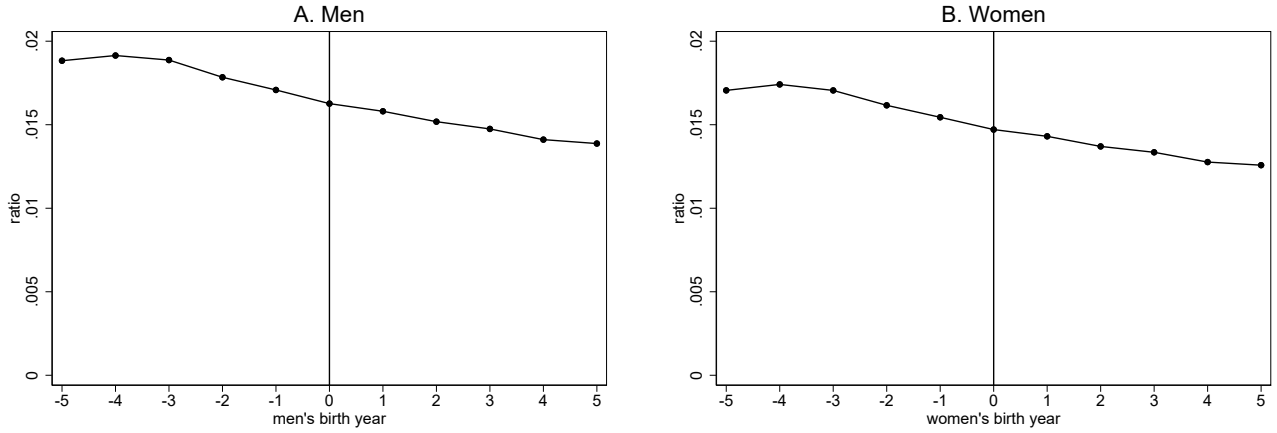
Appendix A

Figure A1: Coeducation of IA-HE by Cohort



Notes: The gray cells indicate coeducation. "JHS" indicates junior high school, and 7th to 9th grade are Japanese junior high school students. All years are school years.

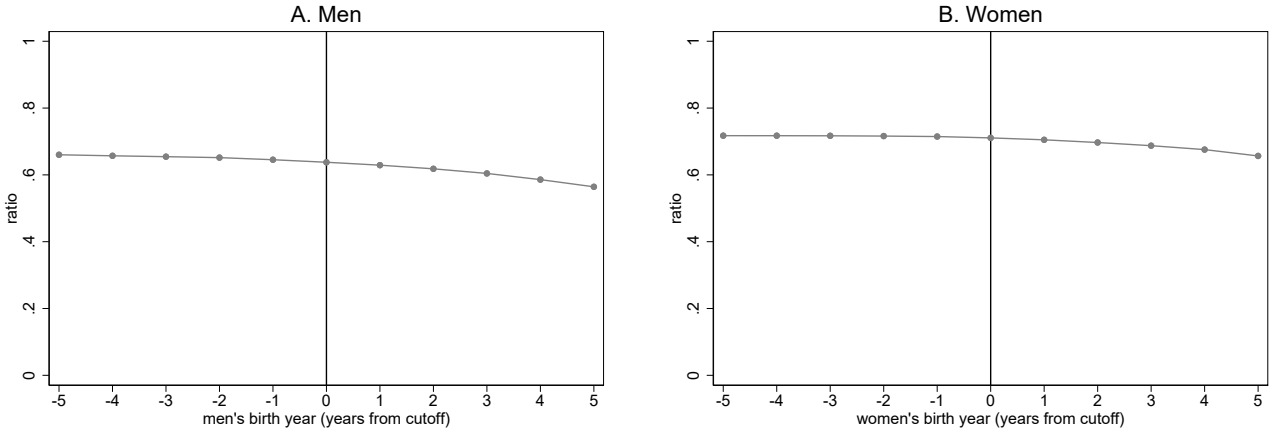
Figure A2: Distribution of the Running Variable using National Census Data



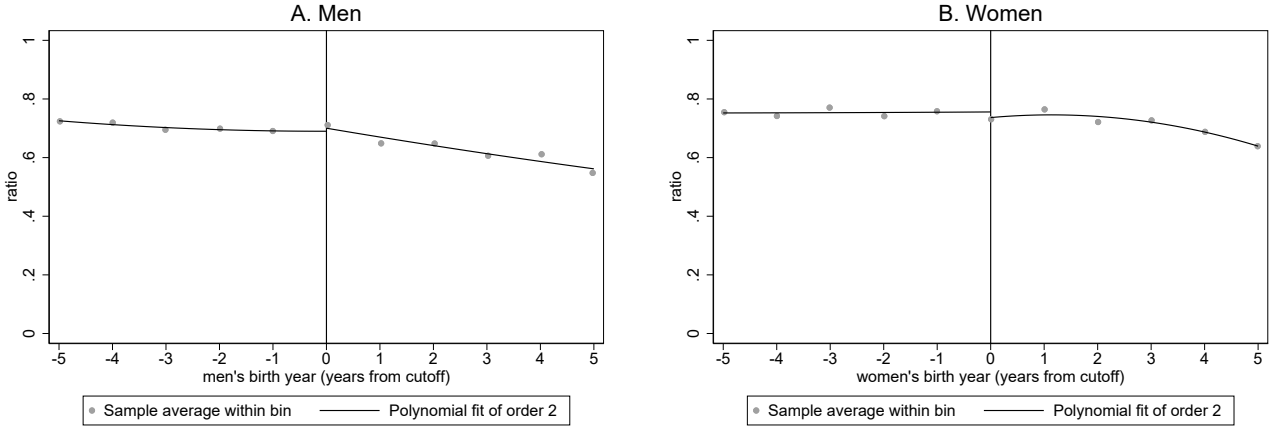
Source: 2015 National Census.
Notes: The Y axis indicates the ratio of each of the 1972-1982 cohorts among the whole Japanese population over 15 years old. The vertical line is at the threshold year, which is normalized to zero. Note that the birth year is represented by the calendar year, not the school year.

Figure A3: Marriage Rate by Birth School Year, by Gender

(a) National Census

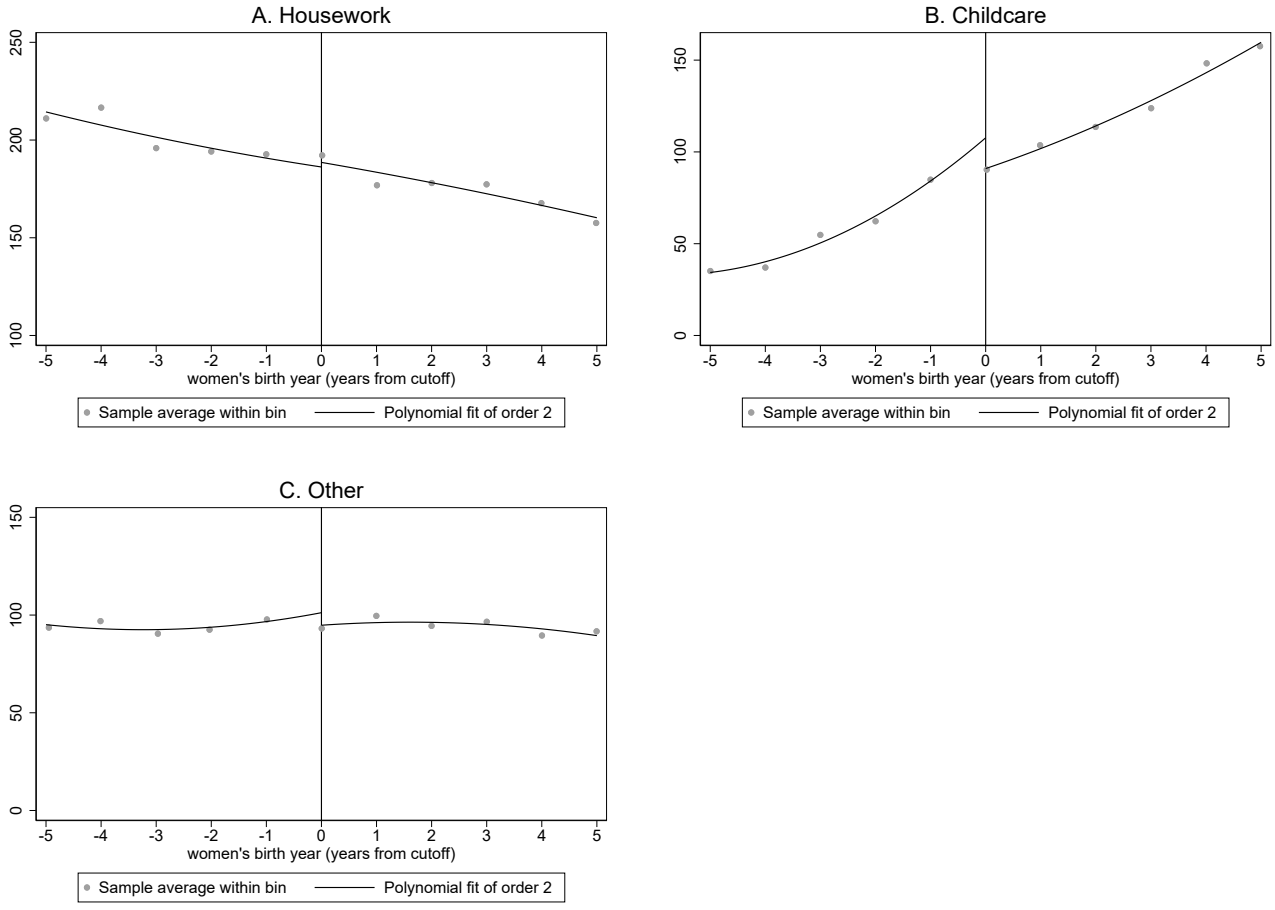


(b) JTUS



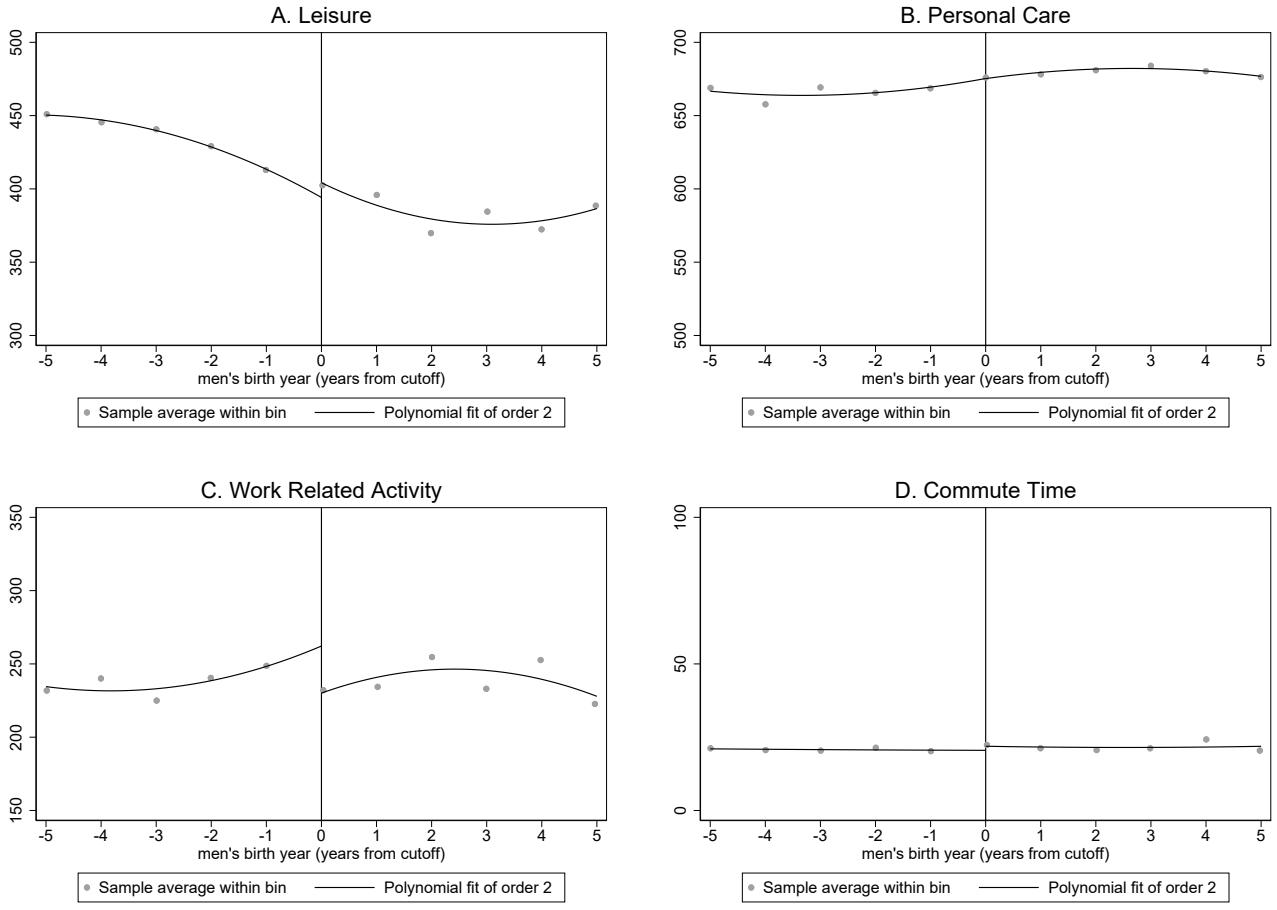
Source: 2016 JTUS, and 2015 National Census.
Notes: The analysis sample consists of the 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. Panel (a) shows connected plots of average marriage rate by birth year, using the published value of the 2015 National Census by the Japanese Statistics Bureau. Panel (b) shows plots of average marriage rate by birth year, and polynomial fitted lines, using 2016 JTUS data.

Figure A4: Women's Weekend Home-Production by Activity Type



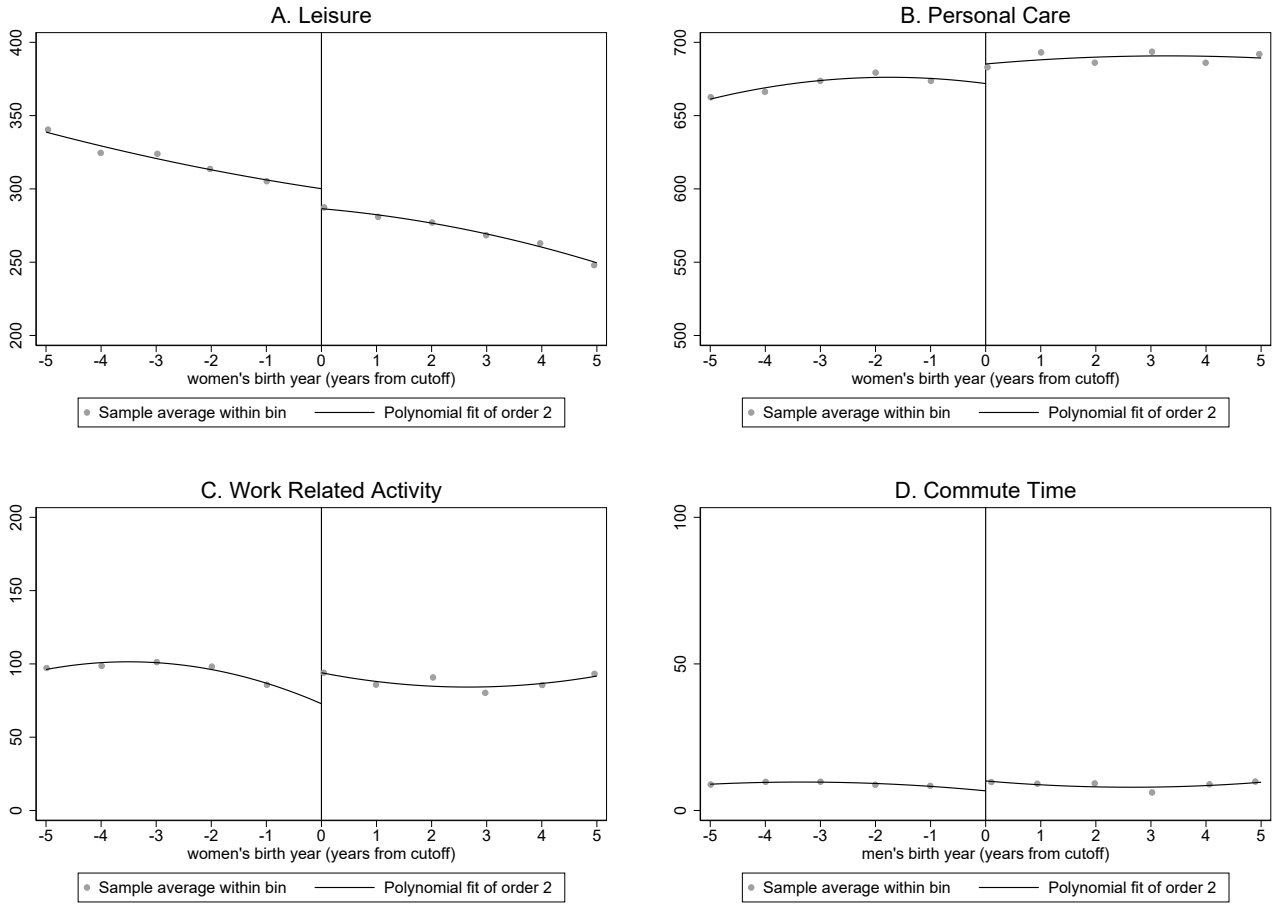
Source: 2016 JTUS.
Notes: The analysis sample consists of the 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero.

Figure A5: Weekend Non-Home-Production Activity Type, Men



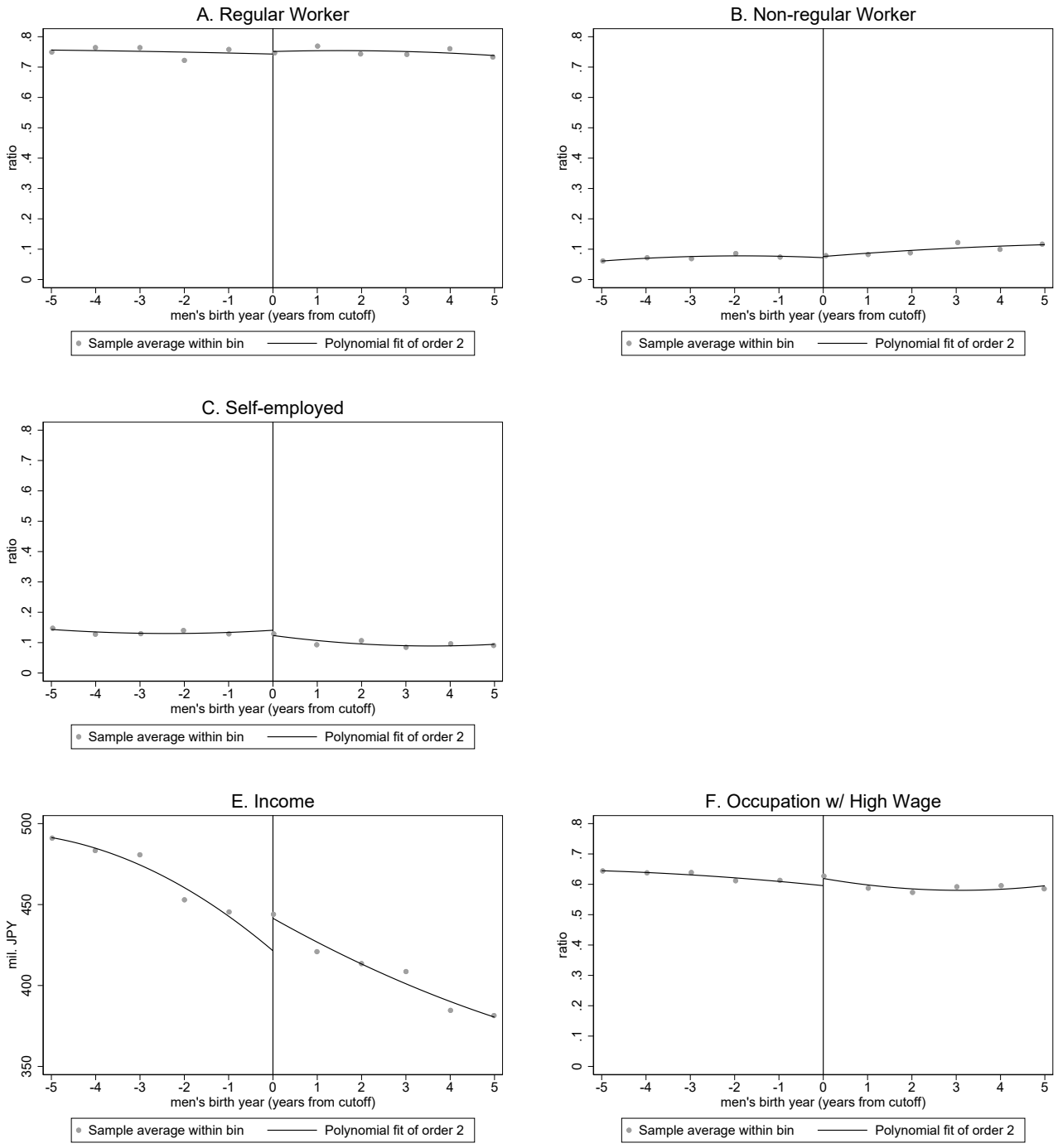
Source: 2016 JTUS.
Notes: The analysis sample consists of the 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. Panel C is the same as Figure 4.

Figure A6: Weekend Non-Home-Production Activity Type, Women



Source: 2016 JTUS.
Notes: The analysis sample consists of the 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. Panel C is the same as Figure 4.

Figure A7: Labor Market Outcomes, Men



Source: 2016 JTUS.
Notes: The analysis sample consists of the 1972-1982 cohorts. The vertical line is at the threshold date, which is normalized to zero. We could not estimate the figure for non-work, as the sample of non-working married men was negligible.

Appendix Table A1: Descriptive Statistics for Time Use (Averages per Cohort, in Minutes)

	Before 1977 Cohorts 1974 to 1976 Mean (Sd)	After 1977 Cohorts 1977 to 1980 Mean (Sd)	Diff (Post 1977-Pre 1977)		Diff % change
Men					
Weekdays					
Work	610.00 (221.90)	609.60 (232.90)	-0.44		0%
Of which commuting time is	61.83 (56.01)	58.35 (52.01)	-3.49	*	-6%
Leisure	210.30 (167.4)	208.20 (164.50)	-2.08		-1%
Home production	37.09 (95.40)	43.87 (98.16)	+6.79	**	+18%
Sleep and eat	582.60 (122.50)	578.40 (126.40)	-4.27		
Weekends					
Work	237.90 (307.50)	239.10 (307.50)	+0.17		0%
Of which commuting time is	20.71 (41.01)	21.43 (41.01)	+0.72		+3%
Leisure	427.80 (258.90)	389.30 (251.90)	-38.48	***	-9%
Home production	106.50 (162.20)	133.20 (171.10)	+26.64	***	+25%
Sleep and eat	667.70 (165.00)	679.40 (165.90)	+11.66	***	+2%
Women					
Weekdays					
Work	301.70 (254.40)	281.40 (260.10)	-20.27	***	-7%
Of which commuting time is	31.98 (41.60)	30.76 (41.46)	-1.22		-4%
Leisure	190.80 (154.70)	178.90 (153.00)	-11.92	***	-6%
Home production	344.20 (218.10)	361.10 (227.00)	+16.91	**	+5%
Sleep and eat	603.30 (125.60)	618.60 (130.10)	+15.28	***	+3%
Weekends					
Work	95.40 (188.00)	88.01 (187.50)	-7.39	*	-8%
Of which commuting time is	9.05 (26.95)	8.65 (26.84)	-0.40		-4%
Leisure	314.70 (210.60)	279.00 (210.40)	-35.76	***	-11%
Home production	354.30 (222.40)	384.20 (229.30)	+29.92	***	+8%
Sleep and eat	675.60 (147.60)	688.80 (154.30)	+13.24	***	+2%

Source: 2016 JTUS.

Notes: The size of the weekday and weekday time-use sample for men is 3,564 and 6,371, respectively. For women, it is 4,589 and 7,712.

These statistics reflect the mean (with standard deviations in parenthesis). The symbols ***, **, and * indicate that the pre- post-reform differences are statistically significant at the 1%, 5%, and 10% level, respectively. Work time includes time commuting to work.

Appendix Table A2: Optimal Bandwidth Suggested by Calonico, Cattaneo and Titiunik (2014)

	Bandwidth Choice	
	Men	Women
Home production (Weekdays)	6.112	6.278
Home production (Weekends)	3.674	3.814
Housework (Weekends)	5.430	4.438
Childcare (Weekends)	4.899	3.667
Other (Weekends)	3.773	6.520
Regular worker	3.988	5.190
Non-regular worker	5.733	4.763
Self-employment	4.989	4.349
Non Work	3.220	3.819
Annual income (JPY)	3.278	3.533
High-wage occupation	6.013	6.014

Source: 2016 JTUS.
Notes: Optimal bandwidth is computed using STATA software rdrobust