Impacts of Childhood Disability on Family: Labor, Marriage, Fertility, and Depression*

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Abstract

Childhood disability has enormous impacts on family members. Using administrative data from Taiwan's National Health Insurance, we study one of the most prevalent and unexpected causes of childhood disability—cerebral palsy (CP). We examine 12,228 children diagnosed with CP and their families from 2000 to 2019. Estimations from an event study approach show that having a CP child decreases the mother's probability of work by 5.6 pp, increases divorce by 1.9 pp and depression by 25%. We also find a significant decrease in long-run fertility. These effects are larger for parents with worse socioeconomic conditions and for CP daughters.

JEL Codes: J12, J13

1 Introduction

An unprecedented number of children has been reported with disability in many countries. In the U.S., the Census Bureau estimates that 4.3% of children under age 18 have a disability.[1] The rise in disability raises great concern due to its costs. The proliferation of childhood disabilities, with their attendant costs, is a cause for serious concern. The impact of childhood disability is manifold, exacting a heavy toll on medical expenses, future development, and family members at large, all of which has been documented in the literature. Researchers have made efforts to quantify these costs, with a view to informing policymakers about welfare and insurance programs.

In the present paper, we aim to shed light on a number of pressing questions related to childhood disability and its effects on family members. We ask the following questions: How does childhood disability affect family members? More specifically, what are the implications for parents with regard to labor market participation, family formation dynamics, mental health, and welfare status? Moreover, we endeavor to discern how these effects vary across different time horizons, and to ascertain both the short- and long-term impacts of having a child with a disability. Furthermore, we seek to identify the families that are most affected by this issue, and to examine the socioeconomic status of these families in greater detail. Do the traits of affected children differ markedly from one another, and how do families as a whole cope with the impact of childhood disability? Lastly, we will investigate the joint decisions that parents make in response to these challenges, and explore the underlying mechanisms behind the effects that we observe.

In the present study, our attention is focused on cerebral palsy (CP), which is the most prevalent motor disability affecting children worldwide. It is estimated that approximately

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[1]Source: Young, Natalie A. E. "Childhood Disability in the United States: 2019" United States Census Bureau. 25 March, 2021. Last accessed 17 July, 2022. <https://www.census.gov/library/publications/2021/acs/acsbr-006.html>

one in every 345 children in the United States suffers from this condition, accounting for nearly a quarter of all childhood disabilities. CP is a disorder that significantly impairs an individual's ability to move, balance, and learn, and is caused by abnormality or damage to the developing brain of infants.

Our decision to focus on CP is motivated not only by its high prevalence, but also by its unique epidemiological characteristics that enable us to econometrically identify its impact on family members. Specifically, CP is undetectable before birth, in contrast to other common conditions such as Down syndrome or spinal muscular atrophy (SMA). The difficulty of identifying the effects of these disabilities lies in the fact that some parents choose to abort their pregnancy upon learning of their child's health status. As a result, comparing the outcomes of children with and without the condition yields a treatment effect where the treatment group is comprised of parents who may or may not decide to have a child upon learning of the diagnosis. However, this selection bias is eliminated in the case of CP, where concerns about selective birth are not a factor. This unique feature allows us to obtain more precise estimates of the impact of CP on family members.

Another significant advantage of our study is the timing of the CP condition. The vast majority of cases of CP are congenital, which stands in stark contrast to conditions such as cancer, where the onset time is unknown and only the diagnosis is recorded in the data. The timing of diagnosis is often correlated with a family's access to medical care, as well as the amount of care provided to the child. By contrast, CP's congenital nature provides a clearer interpretation of the estimates, and allows us to more precisely identify the causal effects of the condition on family members.

To conduct our investigation, we turn to the Taiwanese context, which is well-suited for our purposes due to the availability of rich administrative data and a social security system that is comparable to those of other developed countries.

Our study endeavors to examine the effects of having a child with CP on the family,

3

employing an extensive range of comprehensive administrative data from multiple sources. We combine the National Health Insurance Research Database (NHIRD), Household Registration Data, and Welfare Records to establish a longitudinal dataset that encompasses the entirety of Taiwan's population from 2000 to 2019. This vast dataset provides us with an opportunity to scrutinize various outcomes for family members, such as labor outcomes, family formation, health conditions, and welfare status, among others.

To establish the causal impacts of having a CP child, we employ an event study design. By comparing the outcomes of families before and after the birth of a child with and without CP, we are able to identify the effects that are specifically attributable to having a child with CP, thereby addressing concerns of confounding variables that may have influenced the results. While our study, like others in the field of childhood disability, faces three potential identification challenges, including life-cycle effects, selection on birth, and reverse causality, our unique context and data allow us to overcome these issues effectively. We disentangle the impact of birth by comparing parents of children with CP to those without, and our focus on CP specifically enables us to avoid issues related to diagnosis onset timing. Furthermore, as CP is non-detectable before birth, our estimates remain free from the impact of selection bias from selection of birth. To address the concern of reverse causality, we conducted a pre-trend evaluation and utilized health information to control for parental health in our specifications. These measures enable us to arrive at a clear understanding of the impact of CP on families.

We comprehensively examine a wide range of outcomes, including labor market participation, family structure, mental health, and welfare status, allowing us to provide a nuanced understanding of the unique challenges faced by families with a child with CP. Moreover, we explore the persistence and heterogeneity of these impacts over time, shedding light on the long-term implications of childhood disability on the family. We also investigate the division of labor within households and how families cope with the loss of a CP child,

4

drawing on a comparison between parents whose children died within a short period and those whose children survived for a longer duration.

This paper documents five main findings on the impacts of having a child with CP on parents. First, we find that having a CP child has major impacts on various outcomes. The impacts are categorized into four areas: labor market, family formation, mental health, and other welfare-related outcomes. Notably, we find that mothers experience the most pronounced impacts, with an average decrease of 9% in work and income. CP also affects family formation, with a 2.5% decrease in the share of parents who stay married and a reduction in total fertility of 0.071 if the CP child is the firstborn. Furthermore, our analysis highlights a significant increase in depression rates for mothers, by as much as 25%.

Secondly, we explore the full dynamics of the impacts of having a child with CP on parents over 18 years. Our findings indicate that the effects of having a child with CP are largely persistent in the long-term. We observe a gradual increase in the magnitude of the negative impacts until the child reaches approximately age 3, after which the effects remain consistent for the entire decade. Mothers and fathers alike experience lower employment rates, reduced annual income, higher rates of depression, and increased frequency of depression clinic visits during the first five years. From years 6 to 10, the adverse effects continue to affect parents, and from years 11 to 18, while the negative effects on employment and income attenuate, having a child with CP is still associated with a lower number of offspring, higher depression rates.

Thirdly, we find that younger parents and those with lower income and fewer years of education are more affected in the labor market, with a decrease in the probability of full-time work for mothers and a decrease in income. There is a significant positive effect on the number of children if the CP individual is male, suggesting a potential gender preference among parents.

When we examine parental labor supply, we find that mothers experience more signifi-

cant effects in the labor market compared to fathers. Families in which both parents work show the largest decrease, with mothers more likely to drop out of the labor force than fathers when caring for a child with CP. In contrast, the proportion of families with only the father working experiences the largest increase, followed by those with neither parent working.

Lastly, we compare the outcomes of parents whose CP child survived and those whose child passed away. Following the death of a CP child, parents' labor market outcomes recover, and they are more likely to have another child. Interestingly, there is no significant difference in depression levels between parents with surviving CP children and those whose children died. These results provide novel insights into the impacts of having a child with CP, highlighting the importance of considering different subgroups and outcomes.

Our paper is related to three actively developing literature. The first is the literature on childhood disability. Currie and Kahn (2012) review and summarize the key issues and social security background for childhood disability. Salkever (1982) and Powers (2003) provide early attempts to investigate the effect of childhood disability. More recently, Frijters et al. (2009) study child development associated with child handedness and find that mother's labor supply decreases significantly with a child with poor development. Luca et al. (2019) use a survey data on fragile families. These papers all find large impacts on maternal labor supply. Black et al. (2021) move beyond the focus on parents and examine the effects on siblings. However, restricted by data limitations, these papers do not fully address the identification challenges and mostly are limited to a small set of outcomes, especially maternal labor supply.

Recently, Gunnsteinsson and Steingrimsdottir (2019) and Adhvaryu et al. (2022) are the two papers that are most related to our study and contribute greatly to the span of the results in the literature. Both papers use Danish administrative data and take an event study approach to examine the effects of childhood disability on labor markets, marriage, and

6

fertility. Adhvaryu et al. (2022) focus on cancer while Gunnsteinsson and Steingrimsdottir (2019) investigate a broad set of disability conditions. Both papers find that earning and employment of parents decreased, especially for mothers. Adhvaryu et al. (2022) find that fertility increases while Gunnsteinsson and Steingrimsdottir (2019) document the opposite due to partner dissolution.

Our study adds to the existing literature in several crucial ways, thereby complementing and extending the work of previous researchers. First, we specifically focus on CP, a condition that is widespread and unique in its properties, allowing for a more straightforward isolation of causal effects on family members. Its congenital nature rules out the possibility of post-birth parental behavior confounding the children's health conditions in estimation. In contrast, Gunnsteinsson and Steingrimsdottir (2019) assign weights and averages different sources of disabilities, while Adhvaryu et al. (2022) focus on cancer and uses the differential timing of diagnosis to construct the control groups. Our study also alleviates potential concerns of selection bias in timing of diagnosis by comparing the effects of CP based on birth time.

Second, our context is different. We use data from Taiwan, which has a population of 23 million, more than four times that of Denmark. Additionally, the social security and welfare systems in Taiwan are different from those in Denmark and arguably closer to most other developed countries. Our research, together with the Danish studies, contributes to a deeper understanding of the impacts on families across different contexts.

Finally, our study complements the work of Gunnsteinsson and Steingrimsdottir (2019) and Adhvaryu et al. (2022) by examining additional heterogeneity on the CP children, including their gender and order of birth. Overall, our study builds on and extends the findings of Gunnsteinsson and Steingrimsdottir (2019) and Adhvaryu et al. (2022) by providing new insights into the impacts of CP on families in a different context, with a different econometric design.

Our study also contributes to the literature on the responses of the health shocks and the family members' responses. Fadlon and Nielsen (2019) and Fadlon and Nielsen (2021) document the responses to the health shocks. They use the administrative records to document the labor supply responses to family members' health shocks. Kristiansen (2021) studies studies how parental health shocks affect their children's mental health and educational outcomes.

Finally, our paper connects to the literature on the economics of care-giving, as reviewed by Bauer and Sousa-Poza (2015). While this literature has primarily centered around care for the elderly, our study examines the effects of long-term care needs on families with children with CP. Despite the differences in the care-giving context, our research questions share common ground with this literature. By exploring the impact of CP on various outcomes for family members, we provide new insights into the economic implications of care-giving for families with children with disabilities.

The organization of the paper is as follows: Section 2 provides an introduction to the background and the data. Section 3 presents the descriptive outcomes. Section 4 describes our research design, empirical strategy, potential identification issues, and how we address them. Section 5 presents the main results organized into five main findings. Section 6 presents the robustness checks and additional results. Finally, Section 7 concludes the paper.

2 Background and Data

2.1 Epidemiology

Childhood Disability in General. Previous research indicates that disability rates among children in the United States have been increasing since the early 1990s. As of 2019, it was

estimated that approximately 2.6 million households in the United States had at least one child with a disability, accounting for 7.2% of the 36.7 million households with children under 18 years of age (Young, 2022).

Cerebral Palsy.   In the Taiwanese context, of all childhood disabilities, CP is among the most prevalent, accounting for 23% of such cases. It is estimated that one in 360 newborn babies will have CP, with risk factors including low birth weight, premature birth, multiple births, and infection. Although the causes of CP remain unknown, most cases occur before or during pregnancy, and the condition cannot be detected during pregnancy. The median age of CP diagnosis is 1, and 90% of the CP diagnosis is before age five.

Symptoms.   CP is characterized by movement disorders, such as poor coordination, weak muscles, and tremors, with a majority of individuals also experiencing communication difficulties. Additionally, 25-50% of CP cases involve intellectual or learning disabilities. Unfortunately, CP is currently incurable and persists throughout life, but treatments are available to help individuals with CP become more independent in their daily lives.

2.2   Insurance and Care Setting

Direct Costs.   Caring for an individual with CP incurs various expenses, of which direct medical and therapy costs are the most significant and typically covered by insurance or government programs. These include expenses for doctor and specialist visits, medications, and medical equipment, such as orthotics, wheelchairs, and communication devices. Moreover, individuals with CP often require physical therapy, occupational therapy, and speech therapy, which can be costly and may need to be provided regularly to help improve their motor skills and communication abilities.

U.S. Case. In the United States, many of these expenses can be covered by Medicaid and other government programs. Medicaid coverage is available to severely disabled children with CP. Moreover, the Supplemental Security Income (SSI) program provides financial assistance to low-income disabled individuals, including those with CP. The Social Security Administration (SSA) determines eligibility for SSI using a specific listing of impairments, which includes CP.

Taiwanese Case. In Taiwan, universal health insurance covers most medical expenses for CP. Additionally, there are programs for disability and catastrophic diseases that waive the co-payment and provide subsidies for assistive devices. Similarly, individuals with disabilities who belong to the middle-low income bracket are eligible for monthly cash transfers, akin to the SSI program in the United States. Currently, 2.64% of Taiwan's population falls under this program (Ministry of Health and Welfare, 2023).

2.3   Data Sources and Variables

Data: NHIRD. This study draws on various administrative data, merging three vital sources: the National Health Insurance Research Database (NHIRD), Household Registration Data, and Welfare Records. The NHIRD serves as the official repository for Taiwan's universal health insurance program and contains a wealth of longitudinal data spanning the entire population from 2000 to 2019. It comprises claim-level data for clinic visits, diagnosis, hospitalization, and drug usage, as well as fundamental demographic information such as age and gender. Furthermore, the NHIRD includes labor market information that encompasses work status and wage, enriching the scope of our investigation.

Data: Other. In addition to the NHIRD, our analysis utilizes the Household Registration Data, which furnishes information on family structure, educational attainment, and regis-

tered place of residence for each individual. This information not only allows us to establish familial relationships but also enables us to account for potential spatial disparities in health outcomes. The welfare records also provide a crucial source of information, including data on disability and middle-low income programs. These records allow us to identify the specific causes of disability and the timing of enrollment in these programs, enabling a more nuanced and comprehensive understanding of the population under study.

Measurement. Our analysis identifies individuals with CP based on their diagnosis recorded during clinic visits. The diagnosis is indicated by International Classification of Diseases (ICD) codes, and we use the date of the first diagnosis to determine the onset of CP. The ICD codes for CP are 340 and 343.0 to 343.9 for ICD-9 and G800-G802, G804, G808, and G809 in ICD-10. Additionally, to assess the severity of CP conditions, we supplement our main analyses with intellectual disability as a complementary measure. This approach allows for a more comprehensive understanding of the spectrum of CP-related disabilities.

Sample Selection. Our analysis utilizes two distinct samples: the extended sample and the newborn sample. The extended sample consists of all individuals with a diagnosis of CP in our dataset, which allows us to examine the long-term outcomes of both CP individuals and their family members. In contrast, the newborn sample includes individuals who were diagnosed with CP at birth as well as a randomly selected subset of non-CP children born between 2001 and 2019, and their parents. By including the parents of both groups, we are able to observe parental behavior before the birth of their children. This approach provides a comprehensive understanding of the impact of CP on both individuals and their families over time.

11

3   Descriptive Outcomes

Overview. Our analysis begins with presenting the descriptive outcomes to compare the basic characteristics of individuals with CP and without CP, as well as their family members, throughout their life cycle.

3.1   Outcomes of CP Individuals

To examine the outcomes of CP individuals, we analyze the extended sample at age 30. This age allows individuals to potentially enter the labor force, get married, and have children. Additional statistics for other ages are presented in the Appendix.

Our extended sample includes 7,257,057 non-CP individuals and 11,938 individuals with CP at age 30. Consistent with medical science findings, a higher proportion of men are diagnosed with CP. Furthermore, individuals with CP exhibit significantly poorer human capital and labor market outcomes, including three fewer years of education, a 40 percentage point lower probability of working, and earn 51K NTD less than non-CP individuals, conditional on working. Regarding family formation outcomes, we observe a substantial difference between CP individuals and non-CP individuals, as the former are 30 percentage points less likely to get married.

These differences show how severe the conditions impact various aspects of life.

Table 1: Outcomes of CP Individuals

Outcome/Age	20		30		40		50	
	CP	Non-CP	CP	Non-CP	CP	Non-CP	CP	Non-CP
Male	0.592	0.511	0.570	0.499	0.548	0.499	0.536	0.499
Education	9.412	10.052	10.290	13.096	9.343	12.228	8.695	10.721
Work	0.049	0.081	0.275	0.663	0.378	0.717	0.460	0.730
Annual Income (thousands NTD)	173.815	159.024	315.882	366.316	371.393	434.620	403.132	436.075
Married	0.005	0.018	0.121	0.410	0.331	0.705	0.520	0.759
Disability	0.769	0.020	0.786	0.028	0.719	0.045	0.629	0.068
CP and Disability	0.769	0.000	0.786	0.000	0.719	0.000	0.629	0.000
N	17,075	6,566,930	11,938	7,257,057	10,443	7,377,928	10,246	6,877,851

Notes: Data of this table is from NHIRD 2000 to 2019. We pool all cohorts and calculate the mean outcomes for ages 20, 30, 40, and 50. "Income" denotes annual salary income conditional on working. The unit is in NTD. "Disability" refers to having the certification of disability.

3.2 Outcomes of CP Family Members

Having comprehended the distinct characteristics of individuals with CP, our focus now shifts towards their family members. In Table 2, we provide a comparison of the characteristics and outcomes of parents before the birth of a CP and non-CP child. Prior to birth, we find no substantial dissimilarities in parental age or the number of children between CP and non-CP families. However, we observe that the proportion of working mothers and fathers is marginally higher in families with a CP child.

Additionally, we observe that parental depression rates are slightly higher in CP families. Both mothers and fathers are affected by this phenomenon. Concerning income and educational attainment, we observe that fathers in CP families have similar income levels compared to those in non-CP families. However, mothers in CP families possess lower income and years of education than their counterparts in non-CP families.

Furthermore, we observe that a slightly higher proportion of fathers in CP families are

Table 2: Comparison between CP and non-CP families 5 years before birth

Variable	Mother		Father	
	CP	Non-CP	CP	Non-CP
Age	27.96	27.57	30.62	30.12
Years of Education	12.48	12.63	12.58	12.74
Share Married	0.56	0.54	0.56	0.54
N. Children	0.33	0.34	0.31	0.32
Share Employed	0.56	0.58	0.66	0.66
Annual Income (thousands NTD)	213.42	218.65	285.96	286.85
Share Depression * 1000	16.89	12.40	7.36	6.77
Depression Visit * 1000	81.78	58.39	35.55	34.45
Share Lower Income * 1000	2.32	1.19	2.82	1.91
N	12227	183324	12228	183361

Notes: The data for this table is drawn from the NHIRD spanning the years 2000-2019. We aggregate data from the five-year period preceding the child's birth. Income figures are reported on an annual basis in NTD, and only for individuals who were employed. "Disability" and "Cata. Disease" refer to certification of disability and catastrophic disease, respectively.

enrolled in middle-low income programs compared to fathers in non-CP families.

4   Method

4.1   Research Design

We aim to establish a causal relationship between having a child with CP and its impact on labor market and family formation outcomes for family members. To achieve this, we employ a dynamic difference-in-differences approach as our primary empirical strategy. We compare parents of children with CP to a group of observationally similar parents of non-CP children and estimate the treatment effect of having a child with CP on the outcomes of interest by comparing pre-birth and post-birth outcomes for the two groups.

The formal specification of our regression model is as follows:

$$Y_{i\ell} = \delta_\ell + \sum_{k \neq \circ 1} \beta_\ell D_i \mathbf{1}\{k = \ell\} + \lambda X_{i\ell} + \epsilon_{i\ell}, \tag{1}$$

where i denotes the individual, ℓ denotes the event time or the relative year to the birth year of the child, D is the treatment status, Y is the outcome variable of interest, and δ_ℓ represents the event time fixed effects. The variable $X_{i\ell}$ denotes a set of control variables, including individual fixed effects. We set year $\circ 1$ to be the reference year. The parameter of interest is β_ℓ, which measures the causal effect of having a CP child on the outcome $Y_{i\ell}$.

Controlling for Observable Characteristics. To enhance comparability between the treatment and control groups, we utilize inverse probability weighting to control for observable pre-event characteristics. We match on several variables, including birth year, sex, birth order, parents' highest level of education, ages of parents at the time of child birth, and mother's pre-birth working status. By controlling for these variables, we mitigate the influence of other observable factors and make the treatment and control group more comparable.

Estimating the Average Effect. Using the regression specification outlined in the previous paragraph, we can estimate the average effect of having a child with CP on the outcomes of interest using Equation 2. This provides us with a concise and comprehensive measure of the overall impact of having a CP child, making it easier to compare across all outcomes. The equation is as follows:

$$Y_{i\ell} = \delta_\ell + \beta D_i P_\ell + \lambda X_{i\ell} + \epsilon_{i\ell}, \tag{2}$$

where P_ℓ is an indicator variable for post-event periods ($P_\ell = \mathbf{1}\ell \geq 0$). The estimated average effect, β, provides us with insights into the overall impact of having a CP child on labor market and family formation outcomes for family members.

Heterogeneity Analysis. While the average effect provides a concise summary, examining the heterogeneity of the treatment effect provides a more nuanced understanding of the underlying mechanisms driving the CP birth's impact. By identifying subgroups that are more or less affected by the event, we can gain a better understanding of its implications and inform more targeted policy interventions. Moreover, the heterogeneity specification can help us identify potential sources of variation that may be driving the overall average effect.

To analyze the heterogeneity of treatment effects, we use the following regression model:

$$Y_{i\ell} = \delta_\ell + D_i P_\ell (\beta + \gamma Z_i) + \lambda X_{i\ell} + \epsilon_{i\ell}, \tag{3}$$

where Z_i is the variable of interest representing heterogeneity, and γ is the corresponding heterogeneous effect.[2] This approach allows us to identify which specific factors contribute to the event's impact, enabling us to tailor policies to the needs of those who are most affected.

4.2 Identification Challenges and Solutions

Identification Challenges Overview. There are three potential identification challenges in studying this research question, namely life-cycle effects, selection on birth, and reverse causality, which have been documented in the literature. However, our context and data offer a unique advantage in addressing these challenges. We explain in detail below.

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[2]Since $X_{i\ell}$ includes individual fixed effects, it is not necessary to include Z_i in it.

Solution to Birth Effect The impact of birth can be easily disentangled by comparing parents of children with CP to those of non-CP children. Some prior studies such as Adhvaryu et al. (2022) rely on the timing of the diagnosis of health shocks. In those cases, the earlier treated and the later treated are experiencing different time period of the life-cycle. The outcomes we examine are particularly sensitive to the relative time with birth. Furthermore, the design using the diagnosis timing relies on the assumption that diagnosis time is uncorrelated with observables. By focusing specifically on CP and comparing the outcomes of CP children to those of non-CP children, we avoid this issue and can isolate the effect of CP itself from the effect of having a child.

Solution to Selection on Birth Prenatal testing can lead to selection bias, as parents who anticipate better post-birth outcomes may be more likely to choose to continue a pregnancy despite a disability diagnosis. This can result in an underestimation of the true effect of the disability, as the average effect would have been larger if all families had carried a disabled child to term. However, in the case of CP, the condition's non-detectable nature precludes this type of selection bias. Consequently, our estimates are not affected by the decision to give birth to a child with CP, making the interpretation of our findings simpler and enabling us to draw clear conclusions about the impact of CP on families.

Reverse Causality. Reverse causality poses a potential concern in our study as parents with negative outcomes and health conditions may be more likely to have a child with a disability due to genetic or health-related factors. This could make it challenging to attribute any observed effects on parents to the presence of childhood disability.

To address this concern, we have taken several measures. Firstly, we conducted a pre-trend evaluation to detect any pre-period trends in the outcomes of interest. This evaluation allows us to scrutinize the validity of the parallel trend assumption in our difference-in-

17

differences framework. Our results demonstrate no discernible differential trends in the pre-period outcomes between the treatment and control groups after controlling for the observables.

Secondly, we leveraged our rich data on parental health to control for parental health in our specifications. By ensuring that the health status is comparable between the control and treatment groups, we can minimize the potential impact of reverse causality bias on our results. By taking these steps, we can be confident in the validity of our findings and the impact of childhood disability on parents.

5   Results

We now present our empirical findings. Firstly, we find that having a CP child has major impacts on parental labor, marriage, fertility, and health outcomes. Secondly, we examine the persistence of these effects over time, highlighting their long-term implications. Thirdly, we investigate how the impacts of CP differ across disadvantaged groups, who suffer disproportionately from its effects. Fourthly, we explore how CP affects both parents, and how these outcomes are jointly affected. Finally, we investigate the mechanisms and aftermath of CP, shedding light on the specific pathways through which it operates.

Our main text focuses on a carefully selected set of findings that we believe are particularly significant and relevant. However, for readers interested in a more comprehensive analysis, we provide the complete set of results in the Appendix.

Table 3: Overall Effects

	Mother		Father	
	Est. Effect	% Change	Est. Effect	% Change
Employment	-0.056	-8.91	-0.020	-2.75
	(0.001)		(0.001)	
Earnings (thousand NTD)	-20.723	-8.96	-4.157	-1.69
	(0.431)		(0.562)	
Married	-0.019	-2.56	-0.020	-2.51
	(0.001)		(0.001)	
Cummulative Fertility	-0.071		-0.067	
	(0.002)		(0.002)	
*Depression*1000*	4.192	25.42	1.159	13.72
	(0.467)		(0.333)	
*Depression Visit*1000*	29.243	38.48	11.717	29.31
	(4.297)		(2.957)	
*Low Income*1000*	19.519	1221.56	25.950	1277.24
	(1.274)		(1.378)	
N	195551		195589	

Notes: We use data from NHIRD 2000 to 2019. "Est. Effect" reports the average effect estimated from Equation 2. "% Change" reports the average effect estimated divided by the mean of the control group one year before birth. "Low Income" represents the enrollment of the low-income program. The standard errors are reported in parentheses.

5.1 Finding 1: Major Impacts on Parental Labor, Marriage, Fertility, and Health Outcomes

Table 3 presents the key findings of our study, which illustrate the significant impacts that raising a child with CP can have on various aspects of life, especially for mothers. We have categorized our results into four main areas: labor market outcomes, family formation, mental health, and other welfare-related outcomes.

Regarding labor market impacts, our analysis indicates that having a child with CP leads to significant decreases in work and income, with the most significant effect observed for mothers. Specifically, the likelihood of full-time employment for mothers drops by 5.6 percentage points, corresponding to an 8.9% decline. This effect applies to both the extensive and intensive margin, with income also decreasing by 9.0%. While the decrease in fathers' work is statistically significant, the effect size is smaller. We will further explore the joint decision-making process within families in Section 5.4. Our estimates suggest considerably more significant impacts than those reported in previous studies. For instance, using Danish data, Adhvaryu et al. (2022) found that childhood cancer decreases a mother's labor supply by only 1.5%. Differences in the social security and supporting systems could account for the differences in the estimates. To put our findings into context, the effect on labor supply is comparable to that of having a third child. Luoh (2008) estimated that having a third child in Taiwan would decrease a female's labor supply by 9.78

Secondly, our analysis reveals that having a child with CP has a negative but small impact on marriage, with the share of married decreasing by only 1.9%. However, the presence of a CP child has a significant impact on fertility. If the CP child is the firstborn, the total number of children decreases by an average of 0.071.[3] Our findings suggest that there is no "compensation" effect, where parents have a non-CP child to offset the time

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[3]When estimating the fertility outcome, we restrict our sample to the first and single-born child due to the fact that multiple births are more likely to lead to CP.

allocated to caring for the CP child. This result is consistent with Becker's quality-quantity tradeoff discussion, which suggests that parents allocate scarce resources between fewer but more investment-intensive children or more but less investment-intensive children. Having a CP child is similar to the case where a child unexpectedly requires more time.

Thirdly, our analysis of mental health measures reveals that having a child with CP increases the likelihood of depression for mothers by 25%, with clinic visits increasing by up to 38%. The effects on fathers are also large.

Our findings highlight the significant challenges that parents and their families face when raising a child with CP. They complement previous research in the literature and show that the impacts of having a CP child extend far beyond the child's health outcomes to encompass labor market, family formation, and other welfare measures.

5.2 Finding 2: The effects are long-lasting negative for almost fifteen years after birth.
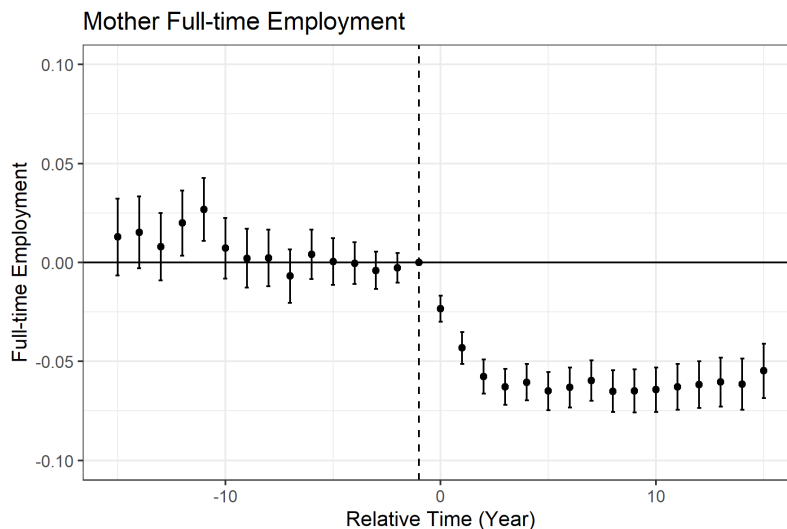

Figure 1: Mother's Work

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates from Equation 1.
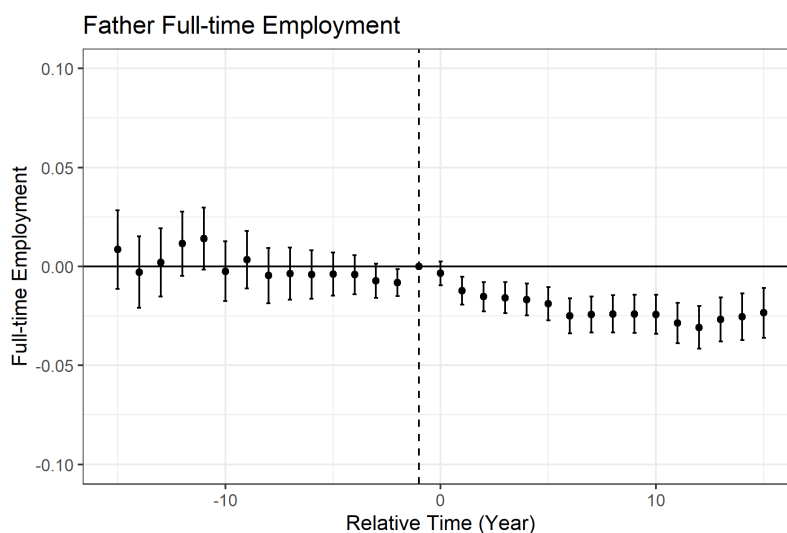
21

Figure 2: Father's Work

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates from Equation 1.

To illustrate these dynamics, we present a series of event study figures in Figure 1 and 2. These figures allow us not only to inspect the dynamic effects but also to evaluate the parallel trend assumptions. For example, Figure 1 shows the labor supply effects after having a child with CP for mothers. We find no detectable difference in the trends before the birth of the child, but after the event, we observe a gradual increase in the labor supply effects that stabilize after 3 years. These effects persist and remain stable over time; in fact, they do not diminish even after 15 years, as the care burden for parents persists even into adolescence.

We present other dynamic results in Table 4 and include the full set of figures in Appendix A. Most of the outcomes we examine follow a similar pattern: the effects gradually increase until around age 3 and then persist at a similar magnitude for the whole decade. One notable exception is the fertility outcome, which shows the same increase in effects for the first few years but mitigates within 10 years.

When we break down the time periods, we find that the effects differ in magnitude

22

Table 4: Persistent Effects

	Mother			Father		
	Y 0-5	Y 6-10	Y 11-18	Y 0-5	Y 6-10	Y 11-18
Employment						
	-0.051	-0.063	-0.056	-0.011	-0.021	-0.023
Annual Income (Thousand NTD)						
	-20.26	-26.99	-22.95	-2.66	-4.46	-8.55
Marriage						
	-0.018	-0.025	-0.025	-0.015	-0.020	-0.018
Number of Children						
	-0.076	-0.090	-0.047	-0.034	-0.037	-0.072
Depression						
	0.005	0.005	0.002	0.000	0.002	0.002
Depression Clinic Visits						
	0.031	0.049	0.022	0.001	0.011	0.012
Low Income Registration						
	0.011	0.012	0.012	0.011	0.021	0.022

 Notes: The estimates of the persistent effects are the weighted average of the estimates from Equation 1. "Y 0-5" averages the effects from year 0 to 5. "Y 6-10" averages the effects from year 6 to 10. "Y 11-18" averages the effects from year 11 to 18.

and direction over time. In the first 5 years after having a child with CP, mothers and fathers experience lower employment rates, with mothers experiencing a larger effect. In addition, having a child with CP caused decrease in marriage and number of children. Moreover, having a child with CP leads to higher depression rates and more frequent visits to a depression clinic, with mothers again experiencing a larger effect.

From years 6 to 10, the negative effects of having a child with CP continue to impact parents' employment and income, with mothers experiencing larger effects. Mothers and fathers also continue to experience higher depression rates and more frequent visits to a depression clinic, with mothers still experiencing a larger effect.

Moving on to the period from years 11 to 18, our findings indicate that most of the previously observed effects persist. However, we observe a mitigation of depression effects during this time.

Our findings suggest that having a child with CP can have significant and long-lasting negative effects on parents. By breaking down the time periods, we can see that the effects differ in magnitude and direction over time.

5.3 Finding 3: Parents with lower income and younger age are more impacted by having a child with CP.

Table 5: Heterogeneity

| | Age at Birth | | Years of Education | | Pre-birth High Income | | Gender: Male | Birth Order |
	M	F	M	F	M	F	Child	Child
M. Work	0.0022	0.0013	0.0011	0.0013	0.0196	-0.0035	0.0084	0.0152
	(0.0007)	(0.0006)	(0.0013)	(0.0012)	(0.0071)	(0.0078)	(0.0072)	(0.0040)
F. Work	0.0028	0.0023	0.0013	0.0030	0.0075	0.0239	0.0125	0.0074
	(0.0006)	(0.0006)	(0.0012)	(0.0011)	(0.0073)	(0.0065)	(0.0065)	(0.0038)
M. Income	-0.0335	-0.0318	-2.0081	1.7430	-5.9104	-8.3169	3.1276	6.2989
	(0.2485)	(0.2210)	(0.5580)	(0.4973)	(2.6750)	(2.9896)	(2.7178)	(1.3875)
F. Income	0.8039	0.4832	0.9004	1.2532	5.4285	6.0804	5.8425	0.2114
	(0.3252)	(0.3086)	(0.6756)	(0.6459)	(4.1574)	(3.4816)	(3.7002)	(1.9016)
M. Marriage	0.0020	0.0012	0.0022	0.0043	0.0168	0.0041	0.0156	0.0221
	(0.0007)	(0.0007)	(0.0014)	(0.0012)	(0.0072)	(0.0013)	(0.0072)	(0.0048)
F. Marriage	0.0017	0.0018	0.0018	0.0039	-0.0038	0.0040	0.0168	0.0220
	(0.0007)	(0.0007)	(0.0014)	(0.0013)	(0.0078)	(0.0077)	(0.0072)	(0.0049)
M. # Children	-0.0026	-0.0015	-0.0127	-0.0107	-0.0277	-0.0264	0.0243	0.1016
	(0.0012)	(0.0012)	(0.0025)	(0.0022)	(0.0119)	(0.0125)	(0.0120)	(0.0098)
F. # Children	-0.0023	-0.0015	-0.0108	-0.0087	-0.0186	-0.0393	0.0215	0.0868
	(0.0012)	(0.0011)	(0.0024)	(0.0020)	(0.0126)	(0.0112)	(0.0117)	(0.0093)
M. Depression	3.83e-5	0.0003	-0.0007	-0.0010	-0.0019	-0.0018	0.0003	0.0035
	(0.0002)	(0.0002)	(0.0004)	(0.0003)	(0.0019)	(0.0020)	(0.0019)	(0.0014)
F. Depression	-0.0004	-0.0003	-0.0002	-0.0001	-0.0005	-0.0019	-0.0013	-0.0005
	(0.0001)	(0.0001)	(0.0003)	(0.0002)	(0.0014)	(0.0013)	(0.0013)	(0.0008)

Notes: This table reports estimates from Equation 3. The rows indicate the outcome variables and the columns indicate the heterogeneity examined. For instance, the first number 0.0022 indicates that mother's work outcome will be 0.0022 higher if the age at birth of the mother increases by 1. "M" stands for mother. "F" stands for father. "Pre-birth High Income" is an indicator of the parent having higher income than the median before birth. "Gender: Male Child" is an indicator variable of the child being male. The standard errors are in parentheses.

Our comprehensive dataset allows us to explore the vast heterogeneity of the effects of having a child with CP. Utilizing Equation 3, we scrutinize the impact of parental age, educational level, pre-birth income, gender, and birth order of the children to investigate which groups are most affected. Our results, presented in Table 5, shed light on this issue.

The findings reveal that families with younger parents and lower income are more profoundly impacted in the labor market by having a child with CP. Specifically, for every five years a mother is younger, the likelihood of exiting the labor force further decreases by 1.1 percentage points. Furthermore, mothers with incomes higher than the median experience a 2.0 percentage point smaller negative impact. This may be explained by the opportunity costs associated with providing care. Nevertheless, similar effects are observed in marriage outcomes, as families with younger parents and lower income exhibit less resilience and more vulnerability to the event of having a CP child. Although years of education generate less profound heterogeneity in the impacts, it is noteworthy that fathers with higher levels of education have a more significant decrease in the total number of children.

Most effects do not vary significantly based on the gender of the child. However, we notice a significant effect on the number of children, where if the CP child is male, the effect on the total number of children is positive. One plausible explanation is the potential son preference among parents who may prioritize having a healthy boy over a healthy girl.

5.4 Finding 4: Mothers are more likely to leave the labor market when caring for a child with CP.

We next investigate how families jointly absorb the impacts of having a child with CP. As shown in Section 5.1, we find that the labor market outcomes of mothers are more greatly affected, while the impacts on fathers are smaller. However, examining the marginal effects
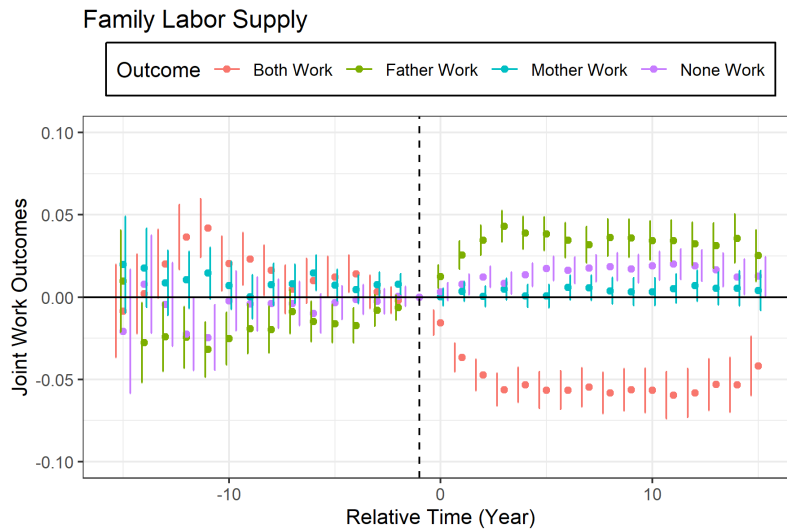
Figure 3: Joint Work

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates from Equation 1. The outcome variables are one of the four indicator variables: both parents work, only the father works, only the mother works, or neither parent works.

on mothers and fathers alone does not provide insight into how labor is divided within households. Therefore, we examine the joint labor market outcomes for both parents.

To investigate the parental joint outcome, we set the outcome variable in our previous specification to one of four indicator variables: both parents work, only the father works, only the mother works, or neither parent works. As in the previous design, we use an event study design to investigate changes in the share of these four groups over time.

The results are presented in Figure 3. We find that the group in which both parents work experiences the largest decrease, with individuals transitioning to the other categories. The category in which only the father works experiences the greatest increase, followed by the category in which neither parent works. These results suggest that mothers are more likely than fathers to drop out of the labor market when caring for a child with CP. Although some families do have both parents leave the labor market, those in which only the father drops out while the mother remains working are rare.

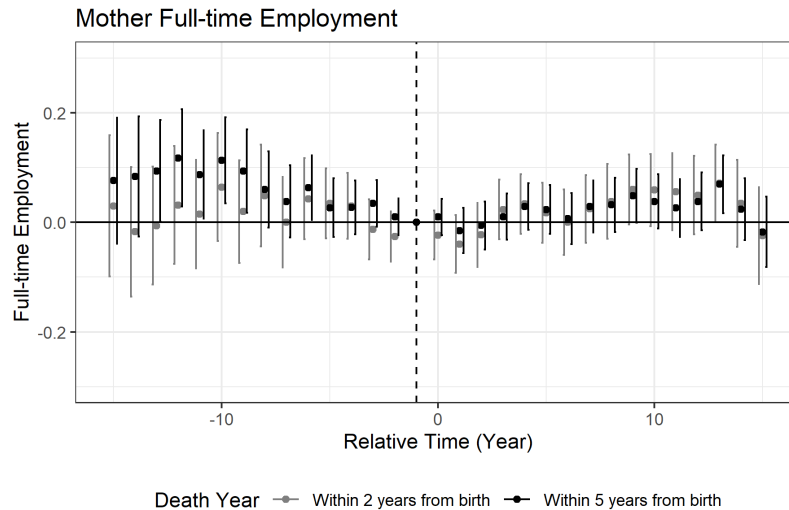## 5.5 Finding 5: Compare outcomes of parents whose CP child died versus those who survived

Figure 4: Mother Work

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates Equation 1 with a modification on the treatment and the control group. The treatment group consists of those with CP who died within two or five years of birth, and the control group consists of those with CP who survived throughout the sample.

In the present section, we delve into the underlying mechanisms that drive the responses observed in the previous sections. We aim to disentangle the effects of death from those of having a child with CP by examining the aftermath of the death of CP children. To this end, we compare the responses of parents whose children with CP died within a short period with those whose children survived longer. These results differ from our prior findings where we analyzed all parents regardless of whether their children survived or not.

The results are presented in Table 6, revealing that although there are differences in the years leading up to their children's death, the labor market outcomes of parents recover after their children's death. The earlier differences may stem from the more intense health condition that a child with CP has, while the later recovery may suggest the care burden of

28

Table 6: Persistent Effects Post Death

	Mother		Father	
	Y 0-2	Y 3+	Y 0-2	Y 3+
Employment				
	-0.028	0.028	0.011	0.007
Annual Income (Thousand NTD)				
	2.955	19.505	4.482	6.721
Marriage				
	-0.021	-0.023	-0.023	-0.018
Number of Children				
	-0.001	0.570	-0.004	0.563
Depression				
	0.004	0.002	0.001	-0.012
Depression Clinic Visits				
	-0.042	-0.037	0.030	-0.042
Low Income Registration				
	-0.014	-0.013	0.005	0.011

Notes: This table reports estimates from Equation 1 with a modification on the treatment and the control group. In this table, the treatment group consists of those with CP who died within two years of birth, and the control group consists of those with CP who survived throughout the sample. We report the weighted average of the estimates. "Y 0-2" averages the effects from year 0 to 2. "Y 3 +" averages the effects from year 3 and beyond.
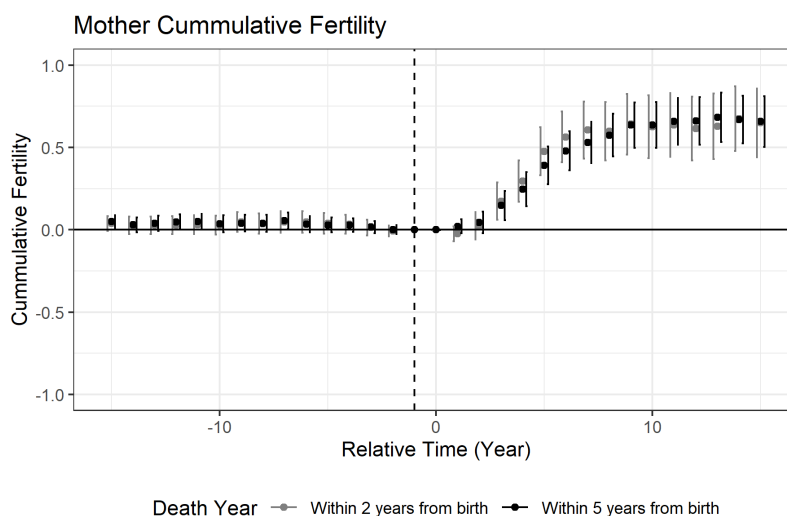
Figure 5: Mother Fertility

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates Equation 1 with a modification on the treatment and the control group. The treatment group consists of those with CP who died within two or five years of birth, and the control group consists of those with CP who survived throughout the sample.

having a CP child.

We would like to emphasize the fertility outcomes of our study. Our previous analysis do not provide evidence of a "compensation" effect, where parents have more children to make up for having a child with CP. However, we do observe that parents are more likely to have a subsequent child following the death of a CP child. Over a decade, the cumulative fertility of parents who experienced the death of a CP child is approximately 0.6 higher than those whose CP child survived.

These findings substantiate the notion that having a CP child has a profound impact on parents. Moreover, the fact that mothers return to the labor market after the death of their CP child does not lend support to the alternative hypothesis that CP has no impact, and the patterns we observe merely reflect poor parental health conditions.

Furthermore, we note that our study did not identify a significant difference in depression

levels between parents with surviving CP children and those whose CP children died. This outcome may be due to a grieving effect, whereby parents experience similar levels of depression regardless of whether the CP child is alive.

6 Robustness Checks and Additional Results

6.1 Balance Panel

Our empirical design pools all cohorts and examine the causal effects of having a CP child. However, due to differences in the timing of each cohort, some samples contribute more to pre-period estimates while others contribute more to post-period estimates. For instance, an individual born in 2015 provides 15 years of pre-birth observation but only 6 years of post-birth observation, whereas one born in 2005 provides 5 years of pre-birth observation and 16 years of post-birth observation. To address concerns regarding potential heterogeneous treatment effects across cohorts, we select the cohorts between 2005 and 2014 so that they all have 5 years of pre-birth and post-birth data. We report the estimates on these years so that the panel is balanced. Our main results presented in the previous sections align with the pattern observed in this chosen cohort, as depicted in Figure 6a and 6b. We include other outcomes in Appendix B.

6.2 Severity

Finally, we present the results with the severity measure. Our measure employs any CP diagnosis in the data. However, CP has a spectrum of severity, and its disturbance to daily life and the need for care also vary. To further emphasize the disability aspect and present the impacts by the severity of the conditions, we restrict the sample to those who have also been diagnosed with intellectual disability at the same time (ICD-9 code 317 to 319 and
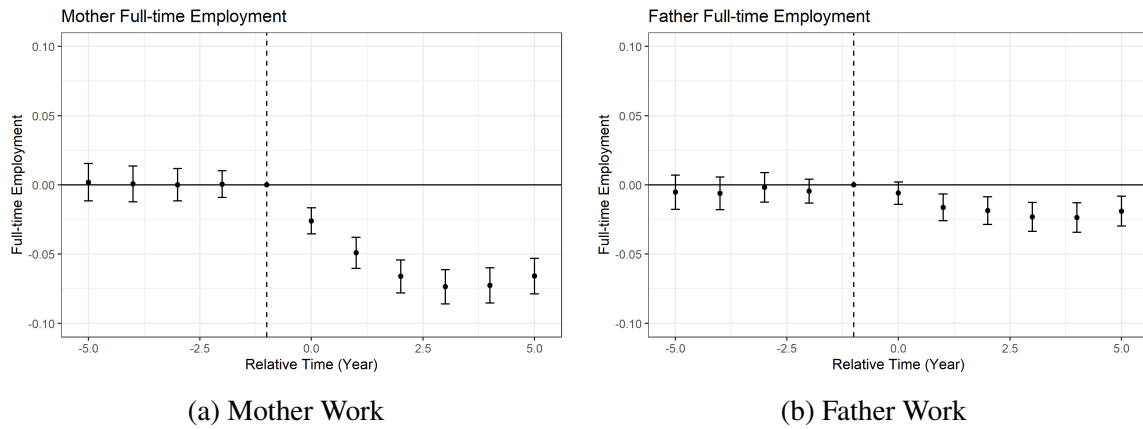
(a) Mother Work   (b) Father Work

Figure 6: Outcomes for Balanced Panel

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates Equation 1 with the sample restricted to the 2005 to 2014 cohort.
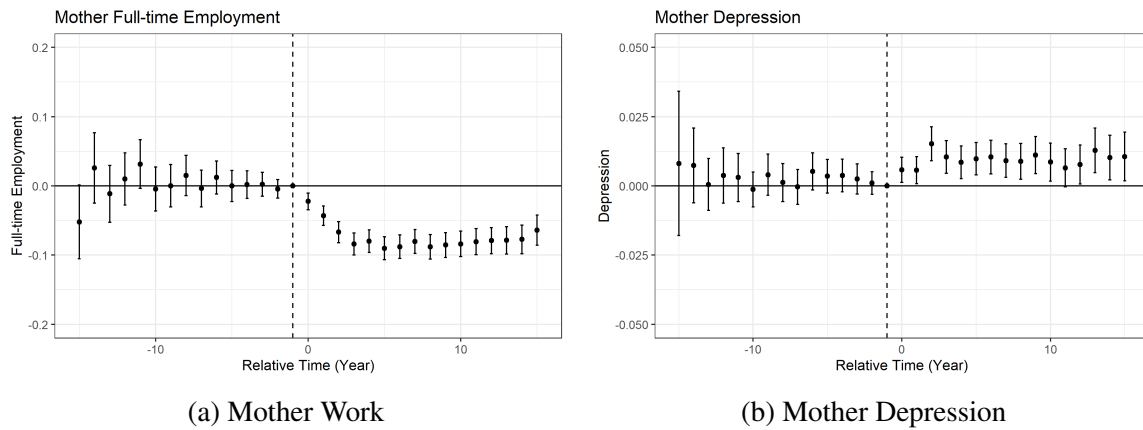

(a) Mother Work   (b) Mother Depression

Figure 7: Outcomes for Intellectual Disability

Notes: The "Relative Time" is relative to the year of birth. The y-axis plots the coefficient estimates Equation 1 with the treatment group defined as those whose children have both CP and intellectual disability.

ICD-10 code F70 to F79).

The results are presented in Figure 7, where we focus on the mother's work and depression outcome to highlight the differences. As shown in the figures, when we focus on those with intellectual disability, the impacts are slightly larger.

7 Conclusion

In conclusion, this study use comprehensive administrative data from Taiwan's entire population to investigate the impact of having a child with CP on family members. Through an event study design, we established the causal impacts of having a CP child and addressed potential identification challenges in our context and data. We examined a wide range of outcomes for family members, providing a comprehensive understanding of the impacts of having a child with CP on the family.

We find that having a child with CP has significant impacts on parents, particularly on mothers, in the labor market, family formation, mental health, and other welfare-related outcomes. Our findings highlight the persistence and heterogeneity of these impacts over time, as well as the division of labor within households.

These findings have important policy implications, emphasizing the need for support and assistance for families with children with CP. Policymakers should consider developing policies targeting maternal employment, family formation, and mental health services to better support these families. Our study highlights the importance of understanding the different dimensions and long-term impacts of childhood disability on families. Further research in this area can inform policymakers to improve the welfare and well-being of families with children with disabilities.

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Appendix

A Figures for Other Outcomes

We present the event study figures for other outcomes in Figure 8 and 9.

B Outcome Table for Balanced Panel

We present the table for the balanced panel in Table 7.

(a) Annual Income

(b) Annual Income (Cond. on Working)

(c) Married

(d) Fertility

(e) Depression Diagnosis (Binary)
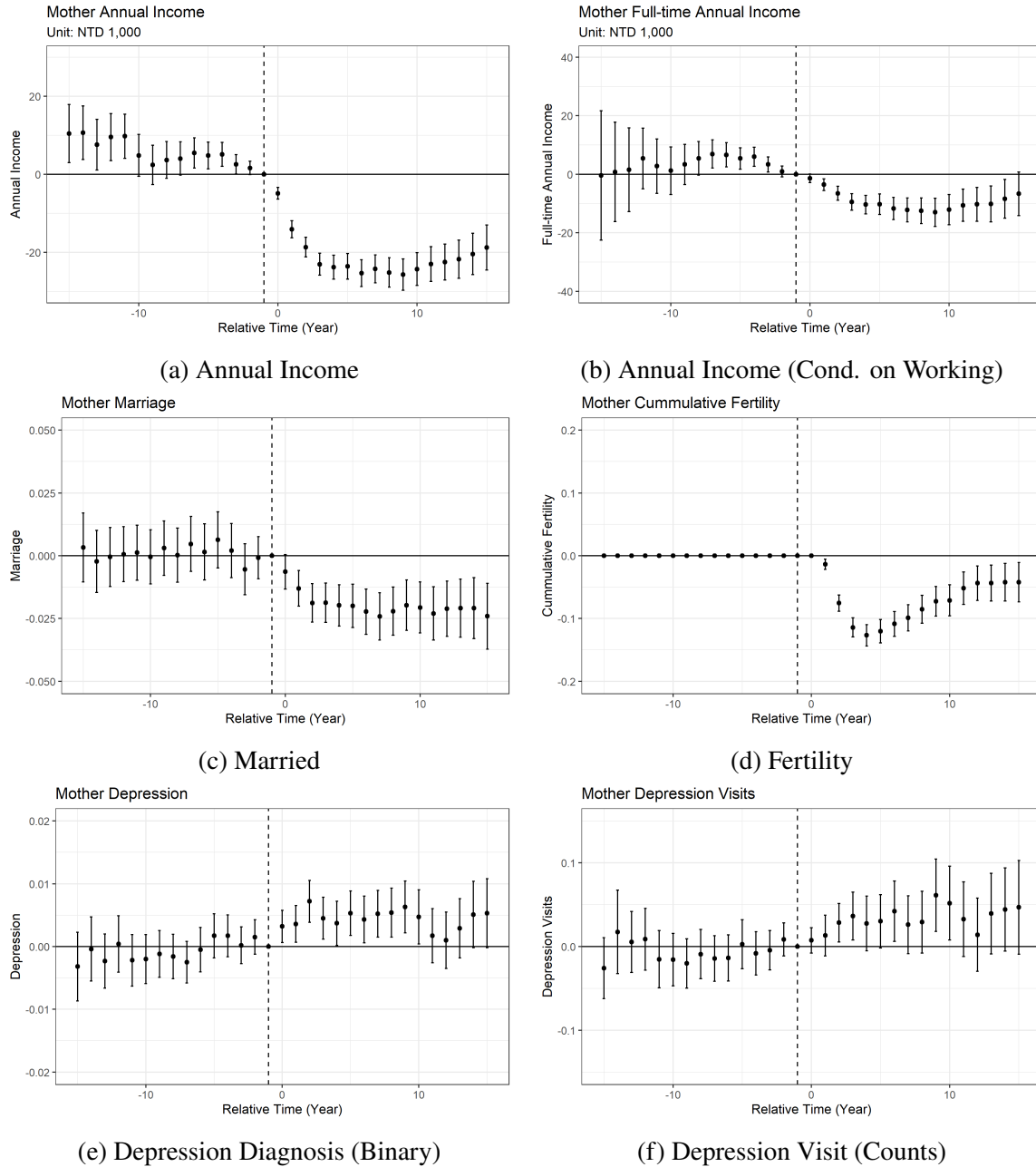
(f) Depression Visit (Counts)

Figure 8: Other Outcomes for Mother

Notes: The figures plot the event study coefficients estimated with Equation 1. The unit of annual income is NTD 1,000 (32.6 USD). "Married" denotes the dummy variable that the mother is married at that period. In "Depression Diagnosis (Binary)", the outcome variable is an indicator variable of whether one visits a doctor for depression in that period. In "Depression Visit (Counts)" the outcome variable sums the number of depression visits in that period.

(a) Annual Income

(b) Annual Income (Cond. on Working)

(c) Married

(d) Fertility

(e) Depression Diagnosis (Binary)
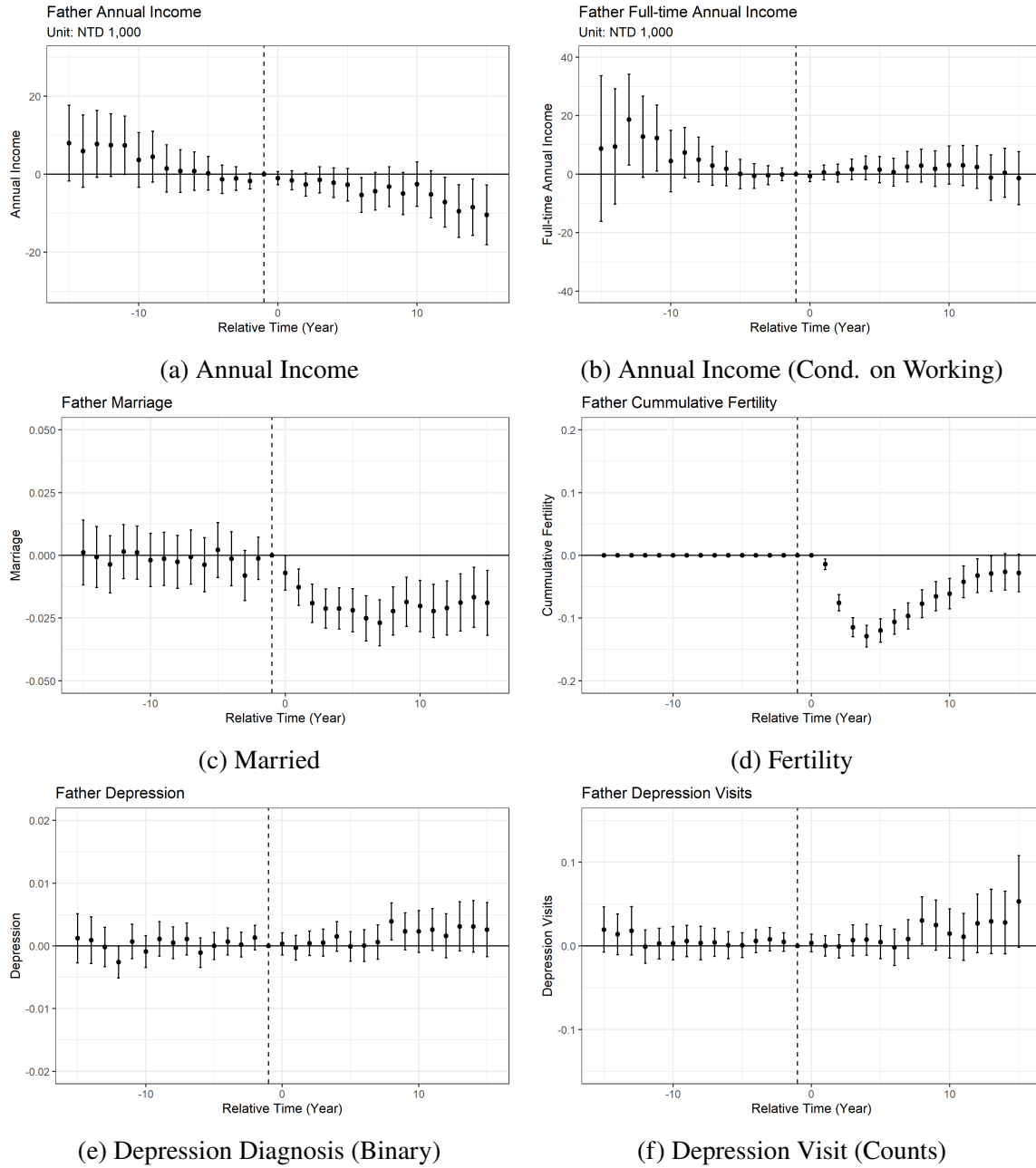
(f) Depression Visit (Counts)

Figure 9: Other Outcomes for Father

Notes: The figures plot the event study coefficients estimated with Equation 1. The unit of annual income is NTD 1,000 (32.6 USD). "Married" denotes the dummy variable that the father is married at that period. In "Depression Diagnosis (Binary)", the outcome variable is an indicator variable of whether one visits a doctor for depression in that period. In "Depression Visit (Counts)" the outcome variable sums the number of depression visits in that period.

Table 7: Effect Estimates with Balanced Panel

	Mother		Father	
	Est. Effect	% Change	Est. Effect	% Change
Employment	-0.059	-9.22	-0.018	-2.41
	(0.002)		(0.002)	
Earnings (thousand NTD)	-20.567	-8.44	-4.298	-1.30
	(0.729)		(0.887)	
Married	-0.015	-1.85	-0.015	-1.89
	(0.002)		(0.002)	
Cummulative Fertility	-0.081		-0.082	
	(0.004)		(0.004)	
Depression*1000	3.500	25.29	1.667	20.40
	(0.908)		(0.598)	
Depression Visit*1000	10.283	15.81	4.100	8.83
	(6.868)		(4.448)	
Low Income*1000	18.350	1568.38	17.317	1245.80
	(2.095)		(2.065)	

Notes: This table reports estimates from Equation 2 with the sample restricted to the 2005 to 2014 cohort. "% Change" reports the average effect estimated divided by the mean of the control group one year before birth. "Low Income" represents the enrollment of the low-income program. The standard errors are reported in parentheses.