

# 國家科學及技術委員會補助專題研究計畫報告

## 女性勞動供給動態選擇與家庭產出之分析：以子女成就為例

報告類別：成果報告  
計畫類別：個別型計畫  
計畫編號：MOST 110-2629-H-007-002-  
執行期間：110年08月01日至111年12月31日  
執行單位：國立清華大學經濟學系（所）

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本研究具有政策應用參考價值：否 是，建議提供機關內政部, 勞動部, 衛生福利部

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本研究具影響公共利益之重大發現：否 是

中華民國 112 年 03 月 31 日

中文摘要：本研究利用家庭動態調查 (PSFD) 的追蹤資料來分析母親就業對子女學業成績的影響。後者乃根據 PSFD 的子女受訪者就讀的高中排名來衡量，而學校排名的構建基礎則綜合了公開資訊及行政數據，包括標準化考試成績和其他評估依據。

我們針對子女自小學入學年齡起至高中前的不同階段衡量其母親就業狀況。Ordered Probit 迴歸結果顯示，母親就業對子女學業的影響視就業時點、工作強度及其是否有配偶而定。對單身母親的子女而言，母親近期就業所帶來的利益似乎高於其成本，且兼職形式的近期母親就業相較於全職有更高的淨利。整體而言，全職母親的子女在學業成就上似無明顯優勢。

中文關鍵詞：母親就業動態、子女成就、學業表現、家庭生產、學校排名、工作強度

英文摘要：We utilize the longitudinal data from the Panel Study of Family Dynamics (PSFD) to analyze the effects of maternal employment on children's academic achievement. The latter is measured by the ranking of high schools attended by the child respondents of PSFD, while school rankings are constructed using a collection of public information and administrative data, including standardized test scores and other evaluation basis.

Maternal employment status is measured over the preceding school years of the child. Our ordered Probit regression results suggest that the child outcomes of maternal employment critically depend on the timing of employment, the intensity of work, and the presence of a helping spouse. In particular, recent maternal employment appeared to provide more benefits than costs for children of single mothers, and part-time form of recent employment would be more beneficial or less detrimental than if such employment was full-time. Overall, being a stay-at-home mom does not appear particularly rewarding in terms of children's academic achievements.

英文關鍵詞：Dynamic Maternal Employment, Child Achievement, Academic Performance, Household Production, School Ranking, Work Intensity

## 計畫成果報告

計畫編號: 110-2629-H-007-002-

計畫名稱: 女性勞動供給動態與家庭產出價值: 以子女成就為例

計畫主持人: 王惠貞

研究成果論文名稱: The Reward of Being a Stay-At-Home Mom: The Dynamics of Maternal Labor Supply and Child Achievement

### 1. Introduction

Women's positions in the labor market had changed drastically in the past century. In the United States, for example, women who worked in the labor market one hundred years ago were primarily young and unmarried, and these women usually exited labor force immediately upon marriage. The labor force participation rate for women 25-44 years of age was about 20 percent back then; coming into the twenty first century, over 70 percent of women in the same age group participate in the labor market (Goldin, 2006). During the same period, the gender difference in education went through a dramatic reversal. In terms of college attainment, the male-to-female ratio of undergraduate enrollment in the United States went from a parity early in the twentieth century to the greatest imbalance post World War II: 2.3 male college students for every female counterpart in 1947. Since then, female college enrollment has been catching up and eventually outnumbered men after the 1980s (Goldin, 2006). These changes, among other things, are thought to have contributed to the convergence of gender wage differential in the past century. However, to this date, data and research continue to show that women, on average or given the same qualifications, earn less than men (See for example, Goldin, 2014; Blau and Kahn, 2016; Juhn and McCue, 2017).

Today, married women today are still less likely to work than unmarried women, albeit by a smaller difference. The presence of children appears to be an important factor behind this remaining difference. According to the published statistics from the March Current Population Survey (CPS), 68.6 percent of married mothers with children under 18 years old were in the labor force in 2017, compared with 76.5 percent of mothers with other marital status. However, for women with no children under 18 years of age, the labor force participation rate was similar for the two groups: 51.7 percent for the married and 51.9 percent for the other marital status.

With the constraint of time, higher labor supply usually means reduced time spent in household production. In part arising from women's needs to balance between work and family, housework-simplifying technology develop in accelerating speed and simultaneously contribute to women's changing roles. Meanwhile, men's hours spent on housework has been increasing over the last five decades, allowing women to spend less time at home (Siegel, 2017). As time went by, many of the household production activities traditionally performed by the women of the house has been substituted by machines, professional services purchased through market, or their male partners (Youssef, 1982). However, not everything that women do is replaceable by market services or men. In particular, the possibility of substitution is absent in women's role of reproduction. For other values produced at home, the substitution and comparative advantage in terms of the quantity of production may not necessarily extend to the quality of the production outcome. For instance, Baker, Gruber and Milligan (2008) suggested that the introduction of a universal childcare program significantly increased maternal labor supply at the same time it led to deterioration in children outcomes and other measures of family wellbeing.

Assessing the shadow value of home production is essential for both the individual decision makers and the policy makers. In particular, as a mother choose between market and nonmarket work, the opportunity cost of working for the market place critically depend on how well her desired family production, such as promoting children's achievement, can be carried out with alternative arrangements. For policy makers, this information also helps design a variety of social and labor market policies that assist professional women balance between work and family. Childcare provision and maternal leave policies are among the common labor market practices in which governments are involved. Moreover, there has been an emerging trend in the labor market towards an environment that allows for a greater degree of job flexibility. It has even been suggested that, the reduction in the temporal constraints of jobs, whether occurring naturally or fostered by policies, may be the last step required to achieve gender equalization in the labor market (Goldin 2014). Such labor market reformation implies a pursue for the middle ground between women's devotion in the labor market and in home production. But would this middle ground lead to better family outcomes, compared to the two extremes? This is an empirical question essential to policy and individual decision making.

Whether or not children's achievement would increase with the time mothers spend at home is not a trivial question. Because maternal labor supply may have influences on children through different channels, the role of the mediating factors and the direction of the combined effect are empirical questions. On the one hand, time of maternal care is reduced and/or replaced by alternative childcare services. This implies a possibly negative effect of maternal labor supply on children wellbeing if it is believed that mother's personal care for their own children are superior to its

substitutes. On the other hand, mother's employment also helps raise family income, which is likely to have a positive effect on children's achievements. A working mother may also enjoy better information and social network which may be beneficial to the education of children. Dahl and Lochner (2012, 2017) found that a \$1000 increase in family income led to a significant increase in the combined math and reading test scores of children, and the effect is especially large for children from disadvantaged families. The positive effect from higher family income will likely mitigate, at least in part, the former negative impact arising from reduced maternal care.

With respect to labor supply decisions, women are more likely to have a complex work pattern than their male counterparts, largely due to the time-sensitive nature of women's reproductive activities. Unlike male workers whose employment status is often dichotomous and persistent during their prime working age, women's labor supply may have marked fluctuations over different stages of their life cycle (see for example, Attanasio et al., 2008; Hotz and Miller, 1988). Therefore, dynamic considerations are essential in examining female labor supply. Moreover, women with a desire to maintain both market and home production may choose to temporarily reduce their work load or take up a more flexible work schedule, if permitted in their line of work, instead of completely withdrawing from the labor market. The role of job flexibility has a growing relevance in modern societies as the rapid development of technology reshapes the structure of jobs. The possibilities of freelance, on-demand jobs are greater than ever due to the growing prevalence of cloud services and matching technology. Prior studies argued that enhanced temporal flexibility in the structure of jobs may be the last step to close the remaining gender gap. For example, Goldin (2014) found that workers sort across workplaces in the compensating differential equilibrium as some (female) workers place higher values on temporal flexibility than the other (male workers), while different firms, occupations and sectors face various costs of providing it.

In this study, we will look into the transitional labor supply patterns of women in Taiwan over a critical period of their life cycle and investigate the differences in the home production outcomes using longitudinal survey data from the Panel Study of Family Dynamics (PSFD). In particular, we will focus on the family outcomes measured by children's academic achievements and connect them to the different forms of maternal labor supply. This study will contribute to the literature in several aspects. In contrast to the majority of maternal employment outcome studies which typically measure the mothers' employment at selected points in time, this study investigates the long-term, dynamic employment choices of the mothers over an extended period of their children's growth. This is allowed by our use of the long-running PSFD surveys which span over a duration of 20 years. In particular, the PSFD follows the children of the main respondents into their adulthood and collects the names of the high schools and colleges attended. To ensure a satisfactory size of sample with

traceability back to the sufficiently early childhood, we focus on the high schools attended and assess the children's achievements with various ranking criteria for the high schools. These child outcomes will then be connected to the mothers' labor supply decisions in various stages of the children's earlier childhood. In addition, interactive factors of the maternal employment effects are explored to identify the circumstances in which maternal employments matters the most. This study will be also the first Taiwanese study to formally estimate the opportunity cost of employment for mothers who take different career paths. Do stay-home mothers produce higher-achieving children than a career mom or the other way around? This is a critical question for both policy makers and all mothers who strive to keep a balance between family and career goals.

Our ordered Probit regression analysis shows that the maternal employment effects critically depend on the timing of employment, the intensity of work, and the presence of a spouse or cohabiting partner. The estimated effect of **recent** maternal employment is robust across specifications. The likelihood to attend a better high school is persistently greater for children of single moms who worked recently, especially when such work was part-time. However, recent maternal employment does not appear beneficial for children of non-single mothers, and it may even be detrimental for the academic outcome if such work is full-time. In contrast, the presence and direction of **early** maternal employment effects are less robust across specifications. These effects are generally absent when stage-dependent static measures are specified. On the other hand, models with dynamic measures of early maternal employment suggest that the presence of any early maternal employment improves children's academic outcomes for non-single mothers, while the effects are reversed for children of single moms.

In the remaining part of this article, section 2 will provide a review of the related studies will be provided in section 2, section 3 will describe the data and empirical strategy, section 4 will present and discuss the regression results, and section 5 will summarize and conclude.

## **2. Literature Review**

The literature on female labor supply is rich and long-standing. Among these studies, the research focusing on the child outcomes of maternal employment generally fall in two categories: early childhood outcomes and academic achievements. Some other studies emphasize the potential channels mediating maternal employment and children performance.

### **2.1. Early-childhood outcomes**

Many studies on the association between maternal labor supply and child outcomes have focused on the influences in the early childhood before school age. In general, prior evidence suggested that the impact of maternal employment depends on family circumstances and other factors

such as income and the timing of the employment. For example, Desai, Chase-Lansdale and Michael (1989) analyzed the impact of maternal employment on their children's intellectual levels measured at 4 years old using the 1986 National Longitudinal Surveys (NLSY). The study found some evidence of an adverse effect when the maternal employment occurred during the first year of the children's life, but this effect was only present for boys from families with higher income, but not for girls or children from lower-income families. Also using the 1986 NLSY, Blau and Grossberg (1992) investigated the relationship between maternal labor supply and the cognitive development of three- and four-year-old children born to mothers of age 21-29. The study attempted to address the endogeneity of women's employment status by using the instrumental variable approach but failed to reject the equality between the OLS and IV regression results. The impact of maternal labor supply was again found to depend on the age of children when the maternal labor supply occurs. In particular, there was a negative effect on children's cognitive development when the mother worked during the first year of the child's life, and the effect was positive when the employment occurred during the second and subsequent years. Blau, Guilkey and Popkin (1996) utilized longitudinal data from the Philippines to investigate the impact of maternal labor supply on infant health. They found little evidence of a causal effect on infant health after the endogeneity of maternal labor supply is accounted for. James-Burdumy (2005) examined the effect of maternal employment on child development using fixed effect models. Some negative effects were found from the maternal employment in the first year of a child's life, but not from the employment in the second or the third year. Lucas-Thompson, Goldberg and Prause (2010) performed a meta-analysis of 69 studies to examine the impacts of early-childhood maternal employment on child achievement and behavioral problems. The authors concluded that the association between early maternal employment and child achievement/behaviors appeared to be largely insignificant except that employment tended to be linked to higher teacher achievement ratings and fewer troubled behaviors such as anxiety and withdrawals. The study again suggested that the association between maternal employment and child achievements significantly depends on family structures and timing of employment.

Related evidence was found in the study of a new universally accessible child care program in Quebec by Baker, Gruber and Milligan (2008). The study found that the introduction of the universal child care policy led to sizable increases in child care utilization and maternal labor supply at same time it adversely affected the measures of children wellbeing and quality of parenting. Children were found to worse off in terms of emotions, social skills, motor skills and physical health.

Overall, the existing evidence is mixed on the early childhood outcomes of maternal labor supply. Where the impacts were present, they appear to depend on the measures of child performance, family income and the timing of maternal labor supply. Interestingly, gender of the children seems

to play a role here as boys are sometimes found to be more vulnerable than girls to their mothers' employment.

## 2.2. Academic achievement

Another group of studies focus on school-age children and analyzed the academic outcomes of maternal labor supply. For example, Miline et al. (1986) utilized micro data on elementary and high-school children to analyze the effects of maternal employment on academic achievements measured by test scores of reading and math. Their results suggested that the impacts of mothers' employment on children's academic achievements are mostly negative except for black elementary school children from one-parent families, and much of the effects are mediated by other family characteristics. Moreover, the intensity of mothers' employment was found to be highly relevant: the negative impact of full-time maternal employment was much greater than that of the part-time maternal employment.

Compared to the studies of early childhood outcomes where the point in time of relevant maternal employment was close to the point of outcome, the academic performance of children is preceded by a longer period of time in which maternal employment may occur. As maternal employment that took place at different stages of childhood may affect a later academic outcome at various degrees, it becomes critical to distinguish the points in time at which maternal employment was measured. A number of researches have adopted an approach which distinguishes early maternal employment from recent employment.

Vandell and Ramanan (1992) focused on children from low-income families and analyzed the impacts of early-childhood and recent employment of the mothers. With selection effects and current family environment accounted for, early maternal employment was found to have a positive effect on children's math achievement, while recent maternal employment was found to have a positive effect on children's reading achievement. Baum (2004) also examined the impacts of early and recent maternal employment on the high school grades of American children using the data from National Longitudinal Survey of Youth. Recent maternal employment was found to significantly reduce student grades, while early maternal employment did not appear to have a significant effect. Dunifon et al. (2013) attempted to identify the causal effect of maternal employment using a large Danish data that followed 135,000 children born between 1987 and 1992 from birth through the 9th grade. Similar to the Baum (2004), the study measured maternal employment over a long duration over a child's life -- in the first three and the first 15 years to be specific -- and estimate the effects on the children's grade point average in the 9<sup>th</sup> grade. Maternal employment was consistently found to affect student grades positively, and the positive effect was especially prominent for part-time employment.



Given our data of origin, it's important to understand the related evidence in Taiwan. A wealth of Taiwanese studies has been devoted to the determinants of educational achievements. However, mothers' employment status was generally not the center of attention in these studies. For example, Huang and Wu (2010) investigated student performance using a panel survey following a group of students in Taipei throughout their middle school years. Results from Ordered Probit models suggested that student performance is significantly affected by family characteristics such as family income, parents' education and marital dissolution. Lu (2017) utilized the data from Panel Survey of Family Dynamics and estimated the effects of son preference and birth order on highest education achieved with the fixed-effect Order Logit approach. In addition to a significant son preference, later birth order was found to positively affect the education achievement, especially when the birth spacing is large. Relevant to our study, Lu (2017) did control for the concurrent maternal employment by using a full-time mother covariate, and its effect on educational achievement was generally significant. Chen et al. (2019) was another recent study related to parents' gender preference in Taiwan. With a data of twins, the study examined the effects of family compositions on educational achievements with an emphasis on sibling rivalry and gender discrimination within a family. They estimated the direct and indirect effects of having a next brother on the first child's education, the latter referring to a sibling size reducing effect and the former a rivalry effect holding the potential sibling size constant. A negative direct effect and a positive indirect effect were found on female firstborns, while both effects were absent on the male counterparts.

In sum, the child academic outcomes of maternal employment in Taiwan were little understood to this date. However, another group of Taiwanese studies on child achievements looks into the roles of parental involvements, which may serve as the mediators between maternal employment and the potential child outcomes. We will discuss these studies next.

### 2.3. Maternal Employment and Parenting Styles

As mentioned previously, the effect of maternal employment on child performance may be mediated by factors such as parenting styles and educational resources. The identification of the mediators may help reveal better management approach and policies that could improve the balance between women's labor force participation and home production. Milne et al. (1986) looked into the roles of mediating factors and decompose the impacts of maternal employment into a direct effect and an indirect effect, the latter being mediated by variables such as income and time use of the family. In a review of past findings, Beyer (1995) made a strong argument that maternal employment per se has little or no effect on children's academic achievements; instead, maternal employment affects parenting styles such as warmth and involvement, which in turns contribute to differences in the child outcomes.

The above studies seemed to suggest that maternal employment leads to lower parental involvement. However, other studies indicated that working mothers are not necessarily the less involved moms. Muller (1995) analyzed a sample of eighth graders and examined the role of parent involvement in mediating the relationship between maternal employment and the children's mathematics achievements. The study found a clear association between the quantity of mothers' employment and selected forms of parent involvement including school volunteering and children's unsupervised time after school, and the part-time working mothers had the highest level of involvement in general. Compared to those whose mothers were working full-time or not working at all, the adolescent children of part-time working mothers were found to perform the best in a math achievement test even when measures of parental involvements were controlled. The performance of children of non-working mothers were marginally better than those whose mothers worked full-time, but the difference was statistically insignificant when measures of parental involvement were controlled. The students' score improvement over two years were also investigated, and maternal employment appear to have no effect on the score improvement except that the students with non-working mothers actually had slightly lower improvement. Hsin and Felfe (2014) found that working mothers trade quantity of time for better quality of time using children's time-diary data. Specifically, maternal employment was found to reduces time in types of activities that may be detrimental to children's development, but it had no significant effect on time spent in activities beneficial to children's development. An Italian study by Del Boca et al. (2016) explored how mothers' employment and formal child care attendance during early childhood affected the children's high school grades. Among the working mothers, the highly-educated ones were found to maintain the time spent with their children in human capital accumulating activities; the latter in in turn positively contributed to the children's academic outcomes.

In Taiwan, a recent study by Shih, Lin and Yi (2018) compared parental involvements and their effect on children's educational performance between single- and dual-earner families. Using two waves of data from the Taiwan Youth Project, the study found that student test scores were positively affected by selected forms of parental involvement, but not by parental employment status, with the former effects varying by dual-earner status. Another Taiwanese study by Teng, Li, Kuo and Zhou (2018) showed that maternal employment was associated with the family's socioeconomic status and parenting styles, with the latter two factors linked to the performance of child adjustment in various processes. For instance, controlling for the socioeconomic status of the family, the study found that employed mothers had the tendency to endorse higher coercive parenting than unemployed mothers.

Taken together, parenting styles may mediate or mitigate the effects of maternal employment; whether it's mediating or mitigating the employment influence is an empirical question. In the

mediating scenario, the estimated effects of maternal employment would be more prominent in the absence of parenting style covariates than when the latter is controlled. The opposite would likely occur in the mitigating scenario; that is, the maternal employment effect would be more prominent when the effects of parenting styles are isolated.

The existing evidence on the academic outcome of maternal employment suggests that the intensity of the employment matters as well as the timing, and the effect may be nonlinear or depending on family circumstances. However, the existing results on the presence and direction of the maternal employment effects were mixed: some studies found negative or no significant effects, while others found positive effects. Moreover, much of the impact of maternal employment may be mediated by parenting styles and other educational inputs, such as time spent with children, human capital building activities and income.

### **3. Data and Empirical Strategy**

#### **3.1. Data**

This study utilizes the PSFD (Chu et al., 1999-2018) to identify the timing and intensity of female labor supply in connection to the academic achievements of the children. PSFD is a longitudinal household survey which began in year 1999 and continued through the present year. The surveys were conducted annually for the years before year 2012 and bi-annually afterwards. The main surveys of PSFD target adult individuals who were at least 25 years of age. In addition, PSFD also follows the children of the original main respondents from 16 years of age into their adulthood. The information of the child respondents was collected in the specially designed child surveys until the age of 25, at which point these grown-up children will be added to the pool of main respondents. In order to obtain measures of children's academic outcomes, our analysis starts from the child respondents and connects them to the corresponding data of their parents, in particular, the employment history of the mothers. The names of high schools attended were collected in the first interviews of all main respondents and every even years of the children samples (coded C).<sup>1</sup> In order to allow for observing maternal employment status at children's early school years, our primary samples of children are obtained from the waves of child surveys between years 2008 and 2018 (namely, CV2008 ~ CX2018). Subsequently, the maximum number of child observations is 4,790 from all the four waves, before further data filtration. In addition to the explicit information on

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<sup>1</sup> The information of school names is available to the public for PSFD surveys no later than year 2014, at which time the release of school identity data was ceased for confidentiality reasons. In an effort to expand our analysis sample to the maximum possible size, we obtained special permission for limited access to the post-2014 school information; the restricted form of which allowed us to measure the quality of the high school attended by a respondent without revealing the school's exact identity. We are grateful to the PSFD team for granting the permission.

education attainment, the survey data contains rich information on family circumstances in various stages of life, including employment, income, marital status, health status, family composition and social network.

Complexity arises as the PSFD data consist of female parent respondents from different stages of life with children of various ages. Most critically, mothers' employment histories are likely incomplete during the earlier stages of children respondents. Therefore, the attempt to identify maternal employment patterns during the children's early childhood will be highly costly in terms of observation loss. To deal with this issue, a reasonable compromise is to focus on the maternal employment patterns during the elementary school years of the children and not earlier. [Table 1](#) describes the number of observations in our main analysis sample of child respondents, whose mothers' employment statuses are observed during the children's earlier elementary school years (ages 6~8), by child respondents' genders and years of survey. The main analysis sample (referred to as sample 1) include 1,435 child respondents collected in four survey years from 2008 to 2018, with the majority drawn from the later years. 51% of the respondents in sample 1 were male and 49% were female. The sample size would expand to 3,142 observations (referred to as sample 2) of child respondents whose mothers' employment statuses are observed during the children's later elementary school years (ages 9~12) but not earlier.

In addition to PSFD, we use a population sample of high school graduates participating in 2002 college entrance exam from College Entrance Examination Center to obtain the high school graduates' entrance exam scores, their admission rates to National Taiwan University and the top 5 universities. We also merged the sample with their labor insurance employment records during the years between 2005 and 2020 to obtain their insured salaries at age 35, and generate various ranking and score measures for high schools. The details will be described in section 3.2.

### 3.2. Empirical Strategy

Our primary question of interest is the impacts of mothers' various employment choices on the educational achievements of children. These impacts will be estimated using regression approaches with two classes of child outcomes discussed below.

#### Measuring Child Academic Achievement: the Construction of High School Ranking

In this study, we measure the children's academic achievements by quality ranks of their high schools attended. In Taiwan, the sorting of students into high schools is ability-based. Like in many Asian countries, middle school students in Taiwan compete for the admission into the "best" high

schools with their academic performance.<sup>2</sup> In general, a more reputable, or simply better ranked high school will attract and be matched with higher-performing students. Therefore, high schools' reputation ranks would serve well to reflect the attending student's academic achievement.

A great challenge rises as the ranking information of high schools is not readily available and requires careful imputation. One may be inclined to rank high schools using the thresholds of test scores applied in the high school admission process, or more directly, to measure student achievements with the individuals' test scores. However, the public information of test scores taken for high school admission is highly incomplete (even at the school level) if not completely unavailable. More importantly, due to differences in the applicable tests and/or the calculation formula designated for each school, the test scores used in high school admission are incomparable across regions or even schools in the same region, especially after the education reform in 2001 (also see footnote 2). Thus, we construct our own high school ranking measures that will reflect the perceived quality and therefore the reputation of the schools, and this is one of the important contributions of this study.

The reputation of a high school may reflect the school's quality attributes in various aspects. Using administrative data sources including Taiwan's labor insurance program and college entrance exam known as the General Scholastic Ability Test (GSAT), we explore a variety of high school quality measures, in particular, those that are likely valued by the perspective students and their parents. Subsequently, our high school ranking method encompasses six different ranking criteria, including the percent of a high school's GSAT-participating students admitted to National Taiwan University (ranking score 1: % NTU),<sup>3</sup> the percent of a high school's GSAT-participating high school students admitted to the top 5 universities (ranking score 2: % Top 5 university), the mean and the median GSAT scores (ranking scores 3 and 4, respectively) of a high school's students, and finally, the median (ranking score 5) and the 25-th percentile (ranking score 6) of labor insurance salaries of these students at age 35. The first four ranking scores are obtained from the population data of the

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<sup>2</sup> The institution of high school entrance in Taiwan has gone through reforms of various scales in the past two decades. Up till year 2000, high schools were largely "assigned" based on regional joint entrance examinations. Students were able to simultaneously apply to a collection of public high schools in the selected region with their indicated order of preference, and the entrance exam scores would then determine a student's priority to be admitted to an elected high school. In the entrance exam era, the admission threshold, namely the lowest entrance exam score of all admitted students in each high school, would serve as a clear ranking basis for the public high schools, albeit not for the private ones. Beginning year 2001, exam-based admissions were abolished and replaced by a complex multi-channel system that allows for individual applications and features standardized "aptitude-like" tests initially known as the Basic Competence Test for Junior High School Students (BCTJHSS). The BCTJHSS was later replaced by Comprehensive Assessment Program for Junior High School Students (CAPJHSS) in 2014. The standardized test results continue to provide an important, though not the only basis in the high school admission decisions. Nonetheless, variation exists across regions and schools in the admission criteria such as the score weighting scheme and the priority order of test subjects. The complexity and variation in the high school admission practices make it difficult to compare the minimum test score across high schools in the post-entrance exam era.

<sup>3</sup> Without regards to departmental differences, National Taiwan University is generally considered the best university in Taiwan.

2002 GSAT participants, and latter two are constructed from these participants' labor insurance and employment records in various years between 2018 and 2020.<sup>4</sup> It is worth noting that the above ranking criteria are based on the education outputs of the high schools; this is in contrast to input-based ranking methods that compare the schools' entrance conditions or students' starting ability.

A list of top high schools (referred to as the top list) is defined based on the sum of the six ranking scores for each high school, and this total score is standardized, called the "score index", so that the highest total score is 100. [Table 2](#) lists the top 50 high schools sorted by the score index. With this score index and the 6 separate ranking scores, we define the child achievement measure as a four-category ordered variable with the values of 0, 1, 2, and 3. Specifically, the ordered categorical variable takes the value of 1 if a high school is ever listed among the top 100 by any of the 6 separate ranking criteria (152 high-schools) but not in the top 100 by the overall score index, the value of 2 if the high school is among the top 51-100 school by the overall scores, the value of 3 if the high school is among the top 50 by the overall scores, and the value of 0 otherwise.<sup>5</sup> Therefore, a greater value of the school categories indicates a better ranked high school and thus a higher academic achievement of the child respondent.

As demonstrated in [Table 3](#), 9.41% of baseline child respondents (sample 1) and 7.73% of the expanded sample 2 attended the top 50 high schools, 5.51% and 6.17% of the two child samples attended the top 51-100 high schools, and around 1% of either sample attended the high schools on the top list (101-152 schools).

Due to the ordinal nature of the high school ranking categories, we will examine the determinants of children's academic achievements using ordered Probit models. The dependent variable ( $Y_i$ ) is the school ranking categories of which category 3 indicates that the child respondent attended a high school among the top 50 high schools, category 2 indicates the top 51-100 high schools, category 1 indicates the top 101-152, and category 0 indicates that the child's high school was not on any of the above three top lists or that he/she did not have a high school attendance record. Behind the observed ordinal outcomes ( $Y_i$ ), a continuous latent variable of children's educational achievement ( $Y_i^*$ ) is specified as a linear function of potential determinants including the mothers' employment status during a specific period preceding the measure of the academic outcome. The estimated model is depicted by the equations below:

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<sup>4</sup> The college entrance exam scores are the weighted total scores with double weights on math and English scores based on the General Scholastic Ability Test (GSAT).

<sup>5</sup> It is worth noting that we also generated the top 25 lists for males and for females separately for comparison, which are composed of the top 43 schools in the overall ranking. Since the observations identified this gender-specific ranking are very close to the ones identified by the top-50 list, we hence adopt the one defined here for our analysis.

$$Y_i = \begin{cases} 0 & \text{if } Y_i^* \leq \theta_1 \\ 1 & \text{if } \theta_1 < Y_i^* \leq \theta_2 \\ 2 & \text{if } \theta_2 < Y_i^* \leq \theta_3 \\ 3 & \text{if } \theta_3 < Y_i^* \end{cases} \quad (1)$$

$$Y_i^* = \text{Maternal employment}_i \cdot \beta + X_i\gamma + u_i, \quad (2)$$

where *Maternal employment<sub>i</sub>* indicates the set of mother's static or dynamic employment status, *X<sub>i</sub>* stands for the set of other covariates including child-specific characteristics (firstborn child, male child with elder sister(s), female child, healthy child), household characteristics (mother's marital status, father's employment statuses, number of children, household income, homeowner, parents' education, parents' ages, and proxies for parenting styles), and locational characteristics (median income of county/city of residence in log form, whether in metropolitan areas),  $\beta$  and  $\gamma$  represent the corresponding coefficients to be estimated, and  $u_i$  is the residual term. The maternal employment variables are measured at various times as indicated. All other household and locational characteristics are measured at child's age 14 (or the interview year immediately preceding it) from the surveys of the main respondents, while the child-specific characteristics are measured at the first interview of child respondents post the age of 16. The last group of variables include the self-reported health status of the child respondent (at the present time), two dichotomous variables indicating each parent's attention to the child's school work (during periods of high school), and the amount of pocket money received from parents (in the previous year). Since the points of measurement for these child survey variables are not standardized at a specific time preceding the academic outcome of interest, we utilize these measures with an implicit assumption that they are reflecting the persistent portion of the characteristics unique to each child.

Mothers' employment choices preceding the child outcome are the key explanatory variables of the child achievement regression as they are a main subject of interest in this study. We will identify different forms of maternal employment measures, including the mother's static employment status measured at different stages of a child's school years and the dynamic patterns of maternal employment over the entire observed period of the distant past. We will discuss the definitions of these maternal employment measures below.

#### Measures of Maternal Employment: Stage-specific Static Measures and the Dynamic Patterns

PSFD contains rich information about the main respondents' current employment status, the tenure of the employment as well as the time of the first job. With the above information, we will construct and explore the employment patterns of female parent respondents according to the following three dimensions: (1) employment status, (2) job intensity, (3) persistence and timing of maternal employment in relation to children's educational stages.

The study will experiment with stage-specific static measures as well dynamic measures encompassing the two dimensions of maternal employment during relevant stages preceding the child outcomes. Both types of measures account for the mother's employment history since the early years of the children's elementary school. For the static measures of maternal employment, the stages in the children growth are classified into ages 6-8 and ages 9-12; the former stage corresponds to the grades 1-2 of children's elementary school years and the latter, grades 4-6. Specifically, the static maternal employment status is measured by whether mother ever worked during her child's earlier elementary school years (ages 6-8), later elementary school years (ages 9-12), and recent year prior to child's attendance to high school (age 14). With respect to the intensity of jobs, we further distinguish between part-time and full-time employment defined by weekly hours worked less than or above 35 hours on average during each specific period or year.

With respect to the dynamic patterns in terms of persistence and timing of labor supply, mothers may choose a persistent or transitional work path throughout the growing periods of their children. In the latter case, a mother may choose to delay employment or temporarily withdraw from the labor force during the critical stages of her children. The dynamic maternal employment status includes five categories measured over the entire duration the child's elementary school years: (1) persistent full-time working moms, (2) persistent part-time working moms, (3) persistent stay-home moms, and lastly (4) working moms with rising employment and (5) working moms with falling employment. The precise duration of measurement is to be determined upon the merge of children-parent samples and a thorough investigation of the observable employment history. Ideally, the specified duration of the child's growing years would cover all years from birth till the age of high school. However, such specification would be infeasible or highly costly in terms of observation loss as it requires an overly long period of the mother's employment history. As a compromised specification, we will also examine the maternal employment transitions during the later stage of the children's elementary school years for robustness check.

Table 4 describes and summarizes the descriptive statistics of explanatory variables used in our analysis by sample. Unless otherwise indicated, all explanatory variables are measured at the child's 14th year of age. In our baseline sample – sample 1, there are 1,435 observations of child respondents' maternal employment statuses observed for both earlier and later elementary school years. In the expanded sample – sample 2, it consists of 3,142 observations of child respondents with observable mother's work records for the later stage of elementary school years (ages 9-12). The maternal employment rates are 60.70% during ages 6-8 of the children and 80.84% during ages 9-12 of the children in the baseline sample 1, while the rates during ages 9-12 of the children is 73.74% in the expanded sample 2 and only 67.78% in the added subsample, sample 3. The recent maternal



employment rate measured at age 14 of the children is around 70% for all three samples with no significant differences.

When distinguished by job intensity, there are 20.49% of mothers worked part-time and 40.21% of mothers worked full-time during child's ages 6-8 in the baseline sample 1. Consistent with the reduced maternal employment rate with sample expansion (sample 2 or 3 compared to the baseline sample 1), more part-time and less full-time working mothers are observed in sample 2 or 3 than in sample 1 during ages 9-12 of the children. It is worth noting that the observations in the expanded sample consists of mothers in relatively older generation than in the baseline sample; hence, such results indicate that younger generation mothers (sample 1) generally have a higher labor participation rate and are more likely to work full-time than part-time during child's ages 9-12. There are though rather small differences in the ratios of part-time and full-time mothers at child's age of 14 between the three samples.

It's worth noting that three variables are used as proxies for parenting styles. In the PSFD children surveys, it is asked how the child respondents receive the attentions from dad and mom on their school work in the high school years. Despite the variables were in fact observed in a time later than the admission to high school, these two variables would still serve well to capture the persistent style of parenting that is unique to each corresponding parent of the child. We also utilize the amount of pocket money received from the parents as a proxy of parenting style. Since this variable is reported at each survey year of the C data, we choose the earliest reported amount available to each child. It is more likely for working parents to give more pocket money to children than non-working parents. It may also serve as a monetary substitute for parents' attentions to children.

It is observed that parent attentions are greater in sample 1 than in sample 2 or 3, and the same direction is also applied to the amount of pocket money between the three samples. A higher percentage of male child with only elder sister(s) in the younger sample (sample 1) seems to correlate with the difference in parental attentions observed between the samples. Differences between the samples are also observed in parents' education, advance maternal age and older parent variables, as the parents in sample 1 are more college educated, more with advance maternal age, and fewer older parents than in sample 2 or 3. Hence, it calls for further investigations to see whether the estimated effects in regressions may be sensitive to the sample selection.

## **4. Estimation Results and Discussion**

### **4.1. Stage-specific static measures of maternal employment**

Table 5 presents the ordered Probit coefficients from our baseline models where stage-specific static measures of early maternal employment are specified. Columns (1) and (2) specify recent employment (at age 14) as well as early employment (during ages 6-8 and 9-12) according to whether the mother was employed at/in the specified point/periods in time, and the specification in column (2) differ from column (1) by adding the single mother status and its interaction terms with the maternal employment variables. In the absence of the interaction terms, we did not find any significant effect of mothers' employment status on the ranking of high school attended, whether the mother's employment was recent or early. Instead, higher household income, homeowners, mother's college education and higher community income significantly increased the quality of high school attended. Interestingly, father's employment slightly, though significantly reduced the probability of a greater academic achievement. Better self-reported health of a child also positively and significantly predicts the academic outcome. On the other hand, other child related attributes such as number of children, child gender and firstborn status are not found to significantly affect the high school ranks of the children in this analysis. One potential cause for the lack of significance in our analysis may be the small sample size, a costly compromise due to the demand for a long-observed history of maternal employment. We will explore the tradeoff between sample size and the earliest available measure of maternal employment in section 4.3.

The benefit and cost of maternal employment may critically depend on whether the mother has a helping spouse or partner. Therefore, we interact the maternal employment variables with single mother status which is a dichotomous variable indicating the mother is not married and not cohabiting with a partner. Limited by data availability, the single status of the mother is obtained from the interview that took place at age 14 of the child or the nearest preceding interview in the absence of former. Therefore, the single mom variable should be regarded as a time-invariant characteristic of the family and may not be reflective of the marital status concurring with a past employment measure. Consistent with the expectation, column (2) shows that the children of single mothers have significantly lower achievements in terms of the high school attended, and the estimated effects of recent maternal employment and early maternal employment at ages 6-8 become significantly positive for this group. Single moms are likely more constrained in both time and income, compared to one with a supporting spouse. For these mothers, the opportunity cost of employment is much greater in terms of the reduction in parenting time and other household production activities, but the income effect from the likely-absent spousal financial support and the gain from social interaction at the workplace would make maternal employment more beneficial or even indispensable for raising children. The significantly positive effect of the recent maternal employment suggests that the gain from employment is especially dominant for single mothers. It's worth noting that that (recent)

household income and house owner status are also controlled in the regression, thus the estimated gain from recent maternal employment is likely beyond what money has to offer.

On the other hand, the same interpretation may not completely apply to the positive effect of early maternal employment. As the single mother status is measured at age 14 of the children, the family circumstances may differ at the time of the early maternal employment measure. Instead, the better child outcome of the early maternal employment for these women likely captures some characteristics of the mothers who would eventually become single, such as an independent personality or higher productivity in market work than in household production activities. The remaining coefficients, including those of the main term maternal employment variables, are largely unaffected by the inclusion of single mother status and the interaction terms. So far, maternal employment status appears to remain irrelevant for children's high school achievement except for families of single mothers.

The models presented above specify employment as a binary status. However, as often found in literature, the effect of maternal employment may depend on the intensity of work, and it's been suggested that part-time maternal employment has the greatest net benefit or the lowest net cost in terms of the child outcomes. In columns (3) and (4), the models further distinguish part-time work from the full-time for all employment measures, including the mother's employment status at all stages and recent employment status of the father. In the absence of the single mom controls, no significant effect is found for maternal employment measures. When single mom status is specified and interacted with the intensity of maternal employment at different stages, we again find that the effects of recent maternal employment become significant for the single moms, but they remain insignificant for the non-single counterparts. For children of single mothers, the maternal employment effects greatly vary by work intensity. The probability for a child to attend a better high school would greatly improve if the single mother worked part-time when the child was 14 years of age, whereas full-time maternal employment at the same point in time would reduce that prospect somewhat. Regarding the early maternal employment status of the single moms, the coefficients are insignificant except for the part-time employment at age 6-8, which is marginally negative. The above results affirm the importance to distinguish the intensity of maternal employment. The coefficients of the remaining covariates are largely robust to the specification differences of maternal employment.

#### 4.2. The Roles of Parenting Styles

Maternal employment decisions may be associated with parenting styles; for example, parents who are strongly attentive to children may be more likely to forgo maternal labor supply for ensure quality time with children. Literature also suggests that maternal employment may affect child

performance through variation in parenting styles; for example, a working mother may pay less attention to their children. Alternatively, compensating adjustment in parenting styles may serve as a mitigation approach that would reduce the impacts of maternal employment on child performance. For example, a working mother may seek to compensate for the sacrificed amount of parenting time with more efficient parenting techniques and better education resources; in other words, they may trade quantity for quality of time. As discussed previously, a mediating story would imply a weaker isolated effect from maternal employment when the mediating parenting behavior is also specified, while a mitigating story would imply a more prominent isolated effect from maternal employment when the compensating efforts are also controlled in the regression.

We utilize three variables as the proxy for parenting styles: whether the mother pays attention to the child's academic performance, whether the father pays attention to the child's academic performance, and the log amount of pocket money from parents to the child. As indicated previously, these parenting proxies are measured at the first interview of each child respondent; thus, one should bear in mind that these measures may capture only the cross-family differences in parenting styles that are persistent over time, but not the within-family variation in parenting styles that could occur along with the rise or fall of maternal labor supply.

Table 6. presents the ordered Probit estimation results with parenting style proxies added to the list of covariates. Across all four specifications, neither parents' attention shows a significant effect on the ranking of high school attended. However, the log amount of pocket money significantly predicts the child's academic performance with a positive coefficient. With the parenting proxies added to the regression, some coefficient estimates of maternal employment gain in statistical significance, while most are similar in sizes and directions compared to those in table 5. Specifically, all measures of maternal employment are significantly positive for children of single moms, including the previously insignificant coefficient for maternal employment at ages 9-12. In addition, in the specifications where different degrees of job intensity are distinguished, the recent full-time maternal employment effect becomes significantly negative for the non-single moms in the presence of the parenting style controls, while the corresponding coefficient for the single moms loses significance. Judging from the above changes, it's likely that the mediating and mitigating roles of parenting styles are both present with respect to the effects of maternal employment on children's academic achievements.

#### 4.3 Sensitivity to Data Expansion

As mentioned previously, the measurement of early maternal employment is highly demanding for panel survey data as it requires a lengthy interval between the point of child outcome (which typically occurs at 15 year of age in our case) and the time of the mother's first observation. The

earlier the maternal employment is measured, the fewer child observations would be available. As a result of compromise, we choose to trace maternal employment in PSFD back to the first two years of elementary school, namely when the children were 6-8 years old. This earliest possible measure of maternal employment restricts the analysis sample to merely 1,435 child observations. Hypothetically, if we were willing to omit the maternal employment status during ages 6-8 of the children and start the measurement at ages 9-12, we would be able to include child respondents who were born in earlier years, and the analysis sample would be expanded to 3,142 observations.

Table 7 demonstrates how sensitive the estimation results would be to the omission of maternal employment measured at child ages 6-8 and the sample expansion. With maternal employment status at ages 6-8 dropped from the equation, the first two columns of Table 7 report the ordered Probit estimates using the original sample of 1,435 observations. The two specifications here are identical to columns (2) and (4) in table 5 except for the omission of maternal employment measured at child ages 6-8. Comparing the corresponding columns of Table 5 and Table 7, the coefficient estimates are largely the same in signs and significance levels, and the magnitudes are very similar where significant.

We then estimate the same shortened equations using the expanded sample and report the results in columns (3) and (4). Several coefficients gain statistical significance with the sample expansion. In particular, the coefficients of dichotomous early maternal employment at ages 9-12 is now significantly negative for non-single mothers in column (3). When work intensities are distinguished, early full-time maternal employment significantly reduces the probability of attending a better high school for children of non-single moms, while recent part-time employment significantly improves their chances of getting into a better high school. For children of single moms, the maternal employment effects become significantly negative from the early employment and significantly positive from the recent employment, regardless the employment was part-time or full-time. The coefficient estimates of the other regression covariates are largely robust to the sample expansion; one exception is the number of children for which the coefficient turns from insignificant to significantly negative. The new estimate agrees with the intuition.

The observed result changes with the sample expansion may be attributable to two possible reasons, one being the added precision (smaller standard error) warranted by the enlarged sample size. Another possibility is that there may be heterogeneity between the original 1,435 observations and the 1,707 newly added observations; the latter have earlier birth years than the former. Cohort differences have received much attention in recent education literature. Unfortunately, we are not able to formally identify a cohort effect in the present study due to the lack of within-cohort variation in the outcome variable. However, the same models can be estimated for the additional 1,707 child

respondents alone to check for signs of systematic differences between samples. These results are reported in columns (5) and (6) of [Table 7](#). Marked differences are found for the coefficients of many covariates in comparison to the original sample of 1,435 child respondents. Specifically, significant coefficients are found for most of the maternal employment measures (including the main terms) and number of children in the older child subsample (sample 3), in spite of its sample size that's not much greater than that of the baseline model. It appears that these factors were more influential in the older generation than for the younger counterpart.

#### 4.4. Dynamic measures of maternal employment

Finally, we estimate the ordered Probit models of child high school ranking using the dynamic measures of early maternal employment. The estimation results are reported in [Table 8](#). The work intensity of recent employment status is again distinguished between part-time and full-time in specification (2), but not in specification (1). For the children of non-single moms, all forms of dynamic early maternal employment have positive effects on the children's academic outcome compared to the reference group for which early maternal employment was never observed. On the other hand, recent maternal employment does not seem relevant regardless the specification of work intensity. Among early employment patterns from age 6 to 12, the coefficient of the falling employment is significant in both specifications with the greatest magnitude among all employment patterns. The above results deviate from those with the static measures of early employment, in which maternal employment effect was completely absent for the non-single moms. The particularly large positive effect of the falling employment pattern is somewhat puzzling as it contradicts the conventional wisdom that younger children benefits more time of the mother. One plausible explanation is that common labor market practices make it difficult for women to start or re-enter a quality profession at an older age. Thus, a falling employment pattern may be capturing career women with an ability to retire or reduce work early as desired.

Based on the coefficients of the interaction terms with single mom status, recent part-time employment (but not the full-time) continues to show great positive effects on academic achievement for the children of single moms, compared to the lack of effects for the non-single mothers. These results agree with those from the previous models as reported in tables 5 and 6. On the other hand, the coefficient estimates are negative for the interactive terms between early employment patterns and single mom status, reversing the otherwise-positive effect for most patterns of any early maternal employment. The coefficients of the other covariates largely resemble those in the models with static measures of early employment.

## 5. Summary and Conclusion

In this study, we investigate the effects of maternal employment on children's academic achievement reflected by the ranking of high school attended. Maternal employment is measured over an extended period of time preceding the point of academic outcome, and the timing and intensity of employment are distinguished. Complexity arises as the PSFD data consist of female respondents from different stages of life with children of various ages. Most critically, mothers' employment histories are often incomplete during the earlier lifetime of grown-up children. Therefore, the attempt to identify maternal employment patterns during the children's early childhood is highly costly in terms of observation loss. As a reasonable compromise, we focus on the maternal employment patterns during the school years of the children.

Existing evidence from the literature is mixed in terms of the presence and directions of maternal employment effects. Our ordered Probit regression analysis shows that the maternal employment effects critically depend on the timing of employment, the intensity of work, and the presence of a spouse or cohabiting partner. With respect to recent maternal employment, the likelihood to attend a better high school is persistently greater for children of single moms who worked recently, especially when such work was part-time. However, recent maternal employment does not appear beneficial for children of non-single mothers, and it may even be detrimental for the academic outcome if such work is full-time. Taken together, recent maternal employment seems to provide more benefits than costs in the absence of a helping spouse, and part-time form of recent employment appear more beneficial or less costly than if such employment is full-time.

The presence and direction of early maternal employment effects are less robust across specifications. When static measures of early maternal employment are specified, early employment effects are generally absent except for single mothers' employment in their children's early school years. However, models with dynamic measures of early maternal employment suggest that the presence of any early maternal employment improves children's academic outcomes for non-single mothers, while the effects are reversed for children of single moms.

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**Table 1.** Baseline Sample by Child Genders and Survey Years

<b>Child's Gender \ Year of Survey</b>		<b>2008</b>	<b>2010</b>	<b>2012</b>	<b>2014</b>	<b>2016</b>	<b>2018</b>	<b>Total</b>	<b>%</b>
<b>Male</b>	<b>N (observation)</b>	<b>33</b>	<b>50</b>	<b>134</b>	<b>156</b>	<b>217</b>	<b>140</b>	<b>730</b>	51%
	min(age of child)	17	17	17	18	17	17	17	
	max(age of child)	17	19	21	23	24	24	24	
<b>Female</b>	<b>N (observation)</b>	<b>19</b>	<b>58</b>	<b>141</b>	<b>151</b>	<b>182</b>	<b>154</b>	<b>705</b>	49%
	min(age of child)	17	17	17	18	17	17	17	
	max(age of child)	17	19	21	23	24	24	24	
<b>Total</b>	<b>N (observation)</b>	<b>52</b>	<b>108</b>	<b>275</b>	<b>307</b>	<b>399</b>	<b>294</b>	<b>1,435</b>	100%
	min(age of child)	17	17	17	18	17	17	17	
	max(age of child)	17	19	21	23	24	24	24	

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

**Table 2.** Rankings and Scores of High Schools in the Top List

overall ranking	overall score	ranking 1 % NTU	ranking 2 % Top5 univ.	ranking 3 mean scores	ranking 4 median scores	ranking 5 median wage	ranking 6 p25 wage
1	100.00	2	2	4	1	6	4
2	99.65	1	1	5	4	3	12
3	99.65	4	5	2	2	4	9
4	99.34	11	7	1	3	8	2
5	98.94	15	15	3	5	1	1
6	98.54	7	3	11	9	5	13
7	98.39	3	6	6	6	2	28
8	98.18	5	8	14	12	10	6
9	98.13	12	12	10	7	7	8
10	97.88	6	4	12	13	15	11
11	97.43	16	11	13	14	9	7
12	97.33	9	13	7	11	16	16
13	96.87	14	14	16	15	12	10
14	96.32	10	10	9	10	11	42
15	95.91	13	16	19	21	17	14
16	94.10	17	18	17	17	28	39
17	93.59	38	24	21	24	14	25
18	93.49	46	37	24	23	13	5
19	93.19	18	19	25	25	27	40
20	93.09	20	21	29	28	29	29
21	91.98	44	32	28	29	19	26
22	91.93	32	29	32	32	21	33
23	91.78	41	30	34	33	25	19
24	91.52	35	25	47	41	24	15
25	91.47	25	23	27	22	55	36
26	91.27	40	33	35	40	23	21
27	91.07	30	36	31	36	32	31
28	90.97	51	42	18	20	30	37
29	90.26	47	35	44	37	31	18
30	89.91	31	38	40	35	41	34
31	89.46	77	43	33	31	20	24
32	89.40	19	17	15	16	69	93
33	89.20	29	27	30	30	42	75
34	87.94	26	46	65	66	38	17
35	87.89	24	34	39	39	49	74
36	87.79	8	9	8	8	56	172
37	87.59	27	26	22	19	73	98
38	87.49	98	41	23	26	18	61
39	87.24	22	22	20	18	63	127
40	86.07	66	62	37	43	33	54
41	85.97	74	44	45	45	36	53
42	85.62	70	49	67	54	34	30
43	85.37	53	52	51	49	52	52
44	85.37	68	59	58	55	37	32
45	84.66	21	20	26	27	100	129
46	84.61	58	54	54	52	39	67
47	84.61	34	51	80	78	26	55
48	84.46	39	39	60	70	70	49
49	83.70	125	67	52	56	22	20
50	83.65	33	55	77	80	47	51

Source: 2002 College Entrance Examination Data and 2005-2020 Labor Insurance and Employment Data, with authors' calculations.

**Table 3.** Educational Achievement by High-School Ordered Category and Sample

High school category	Sample 1 (Baseline)		Sample 2 (Expanded)		Sample 3 (Sample2 – Sample1)	
	n(obs)	%	n(obs)	%	n(obs)	%
0	1,205	83.97	2,676	85.17	1,471	86.17
1	16	1.11	29	0.92	13	0.76
2	79	5.51	194	6.17	115	6.74
3	135	9.41	243	7.73	108	6.33
Total	1,435	100	3,142	100	1,707	100

Source: PSFD (Chu et al., 1999-), 1999-2018, 2002 College Entrance Examination Data and 2005-2020 Labor Insurance and Employment Data, with authors' calculations.

**Table 4.** Summary of Descriptive Statistics by Sample

Variable	Sample 1 (Baseline)		Sample 2 (Expanded)		Sample 3 (Sample2 – Sample1)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Mom worked (ages 6-8)	0.6070	0.4886				
Mom worked (ages 9-12)	0.8084	0.3937	0.7374	0.4401	0.6778	0.4675
Mom worked (age 14)	0.7073	0.4552	0.7069	0.4553	0.7065	0.4555
Mom worked part-time (ages 6-8)	0.2049	0.4038				
Mom worked full-time (ages 6-8)	0.4021	0.4905				
Mom worked part-time (ages 9-12)	0.2502	0.4333	0.3004	0.4585	0.3427	0.4748
Mom worked full-time (ages 9-12)	0.5582	0.4968	0.4370	0.4961	0.3351	0.4722
Mom worked part-time (age 14)	0.1213	0.3265	0.1076	0.3099	0.0961	0.2948
Mom worked full-time (age 14)	0.5861	0.4927	0.5993	0.4901	0.6104	0.4878
Single mom	0.0293	0.1686	0.0302	0.1713	0.0310	0.1735
Mom's attention	0.3171	0.4655	0.3033	0.4598	0.2917	0.4547
Dad's attention	0.2983	0.4577	0.2896	0.4537	0.2824	0.4503
ln(pocket money)	4.2165	8.3600	3.5506	8.8504	2.9907	9.2077
Dad worked (age 14)	0.8676	0.3390	0.8857	0.3182	0.9010	0.2988
Dad worked part-time (age 14)	0.0530	0.2240	0.0633	0.2436	0.0721	0.2587
Dad worked full-time (age 14)	0.8146	0.3887	0.8224	0.3822	0.8289	0.3767
Number of children	2.5652	0.8705	2.5926	0.8404	2.6157	0.8138
Firstborn child	0.3470	0.4762	0.4007	0.4901	0.4458	0.4972
Male child with elder sister(s)	0.2279	0.4196	0.1887	0.3914	0.1558	0.3628
Female child	0.4913	0.5001	0.4787	0.4996	0.4681	0.4991
Healthy child	0.5930	0.4914	0.5993	0.4901	0.6046	0.4891
Household income (NT\$10,000)	6.4886	4.9831	6.2378	5.0486	6.0270	5.0949
Homeowner	0.5847	0.4930	0.5789	0.4938	0.5741	0.4946
Dad college educated	0.3763	0.4846	0.3122	0.4635	0.2583	0.4379
Mom college educated	0.2662	0.4421	0.1951	0.3963	0.1353	0.3422
Advance maternal age	0.0244	0.1543	0.0127	0.1121	0.0029	0.0541
Older parent	0.2028	0.4022	0.2187	0.4134	0.2320	0.4222
ln(median income of county/city)	13.5797	0.1832	13.5434	0.1805	13.5129	0.1724
Metropolitan areas	0.6899	0.4627	0.6505	0.4769	0.6175	0.4862
Number of observations	1,435		3,142		1,707	

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

**Table 5.** Ordered Probit Models of High School Attended: Maternal Employment by Stages

VARIABLES	(1)	(2)	(3)	(4)
Mom worked (ages 6-8)	0.0844	0.0899		
Mom worked (ages 9-12)	0.0965	0.0966		
Mom worked (age 14)	-0.1091	-0.1131		
Mom worked part-time (ages 6-8)			0.0708	0.0784
Mom worked full-time (ages 6-8)			0.0948	0.0887
Mom worked part-time (ages 9-12)			0.0729	0.0787
Mom worked full-time (ages 9-12)			0.1412	0.1489
Mom worked part-time (age 14)			0.1591	0.1118
Mom worked full-time (age 14)			-0.2077	-0.2038
Single mom		-7.0899***		-3.5869***
Mom worked (ages 6-8)*Single mom		3.2481***		
Mom worked (ages 9-12)*Single mom		0.2714		
Mom worked (age 14)*Single mom		3.2143***		
Mom worked part-time (ages 6-8)*Single mom				-0.3857**
Mom worked full-time (ages 6-8)*Single mom				-0.1498
Mom worked part-time (ages 9-12)*Single mom				-0.0150
Mom worked full-time (ages 9-12)*Single mom				0.0056
Mom worked part-time (age 14)*Single mom				4.8445***
Mom worked full-time (age 14)*Single mom				-0.5754*
Dad worked (age 14)	-0.3100**	-0.3376***		
Dad worked part-time (age 14)			-0.3240	-0.3583
Dad worked full-time (age 14)			-0.2474*	-0.2922**
Number of children	0.0007	-0.0084	-0.0095	-0.0218
Firstborn child	0.0999	0.0876	0.1055	0.1071
Male child with elder sister(s)	-0.1422	-0.1507	-0.1250	-0.1231
Female child	-0.1227	-0.1066	-0.1483	-0.1236
Healthy child	0.2602***	0.2558***	0.2586***	0.2689***
Household income (NT\$10,000)	0.0161*	0.0168*	0.0202**	0.0214**
Homeowner	0.2533***	0.2415***	0.2311**	0.1966**
Dad college educated	0.1635	0.1709*	0.1608	0.1552
Mom college educated	0.3665***	0.3543***	0.3464***	0.3562***
Advance maternal age	0.3241	0.3178	0.2946	0.3064
Older parent	-0.1775	-0.1305	-0.1294	-0.0900
ln(median income of county/city)	0.5429*	0.5335*	0.5175*	0.4991*
Metropolitan areas	-0.0800	-0.0812	-0.0832	-0.0933
$\theta_1$	8.6480**	8.4678**	8.3344**	8.0134**
$\theta_2$	8.6982**	8.5181**	8.3849**	8.0643**
$\theta_3$	8.9997**	8.8199**	8.6883**	8.3698**
Observations	1,435	1,435	1,435	1,435

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 6.** Ordered Probit Models of High School Attended: Maternal Employment by Stages with Parenting Styles

VARIABLES	(1)	(2)	(3)	(4)
Mom worked (ages 6-8)	0.1014	0.1090		
Mom worked (ages 9-12)	0.0952	0.0878		
Mom worked (age 14)	-0.1195	-0.1199		
Mom worked part-time (ages 6-8)			0.1053	0.1116
Mom worked full-time (ages 6-8)			0.0956	0.0910
Mom worked part-time (ages 9-12)			0.0497	0.0439
Mom worked full-time (ages 9-12)			0.1784	0.1845
Mom worked part-time (age 14)			0.1694	0.1289
Mom worked full-time (age 14)			-0.2466*	-0.2435*
Single mom		-7.0040***		-3.6667***
Mom worked (ages 6-8)*Single mom		3.0985***		
Mom worked (ages 9-12)*Single mom		0.6121*		
Mom worked (age 14)*Single mom		2.9372***		
Mom worked part-time (ages 6-8)*Single mom				-0.4278**
Mom worked full-time (ages 6-8)*Single mom				-0.1742
Mom worked part-time (ages 9-12)*Single mom				0.4214
Mom worked full-time (ages 9-12)*Single mom				0.0628
Mom worked part-time (age 14)*Single mom				4.5031***
Mom worked full-time (age 14)*Single mom				-0.6402
Mom's attention	-0.1939	-0.1815	-0.1761	-0.1316
Dad's attention	0.3349	0.3224	0.3386	0.3062
ln(pocket money)	0.0151***	0.0150***	0.0165***	0.0161***
Dad worked (age 14)	-0.3356***	-0.3626***		
Dad worked part-time (age 14)			-0.3516	-0.3872*
Dad worked full-time (age 14)			-0.2670**	-0.3096**
Number of children	0.0078	0.0003	-0.0029	-0.0125
Firstborn child	0.0974	0.0876	0.1024	0.1045
Male child with elder sister(s)	-0.1300	-0.1384	-0.1098	-0.1116
Female child	-0.1245	-0.1092	-0.1568	-0.1358
Healthy child	0.2498***	0.2449***	0.2512***	0.2635***
Household income (NT\$10,000)	0.0162	0.0168*	0.0204**	0.0220**
Homeowner	0.2607***	0.2514***	0.2350***	0.2001**
Dad college educated	0.1216	0.1301	0.1197	0.1169
Mom college educated	0.3348***	0.3223***	0.3085***	0.3160***
Advance maternal age	0.2907	0.2812	0.2515	0.2443
Older parent	-0.1560	-0.1126	-0.0964	-0.0573
ln(median income of county/city)	0.5813*	0.5773*	0.5447*	0.5354*
Metropolitan areas	-0.1123	-0.1119	-0.1115	-0.1181
$\theta_1$	9.2389**	9.1351**	8.7930**	8.6068**
$\theta_2$	9.2895**	9.1859**	8.8440**	8.6582**
$\theta_3$	9.5934**	9.4900**	9.1500**	8.9663**
Observations	1,435	1,435	1,435	1,435

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7.** Ordered Probit Models of High School Attended (without the Earliest Measure of Maternal Employment): Baseline Sample versus Expanded Sample

VARIABLES	Sample 1 (Baseline)		Sample 2 (Expanded)		Sample 3 (Sample2 – Sample 1)	
	(1)	(2)	(3)	(4)	(5)	(6)
Mom worked (ages 9-12)	0.1402		-0.1221*		-0.2277**	
Mom worked (age 14)	-0.1006		0.1158		0.1879*	
Mom worked part-time (ages 9-12)		0.1126		-0.0940		-0.1944**
Mom worked full-time (ages 9-12)		0.2013		-0.1468*		-0.2858***
Mom worked part-time (age 14)		0.1213		0.2474**		0.1852
Mom worked full-time (age 14)		-0.1967		0.1019		0.2073**
Single mom	-3.5307***	-3.8324***	-4.2462***	-4.2546***	-4.3673***	-4.3861***
Mom worked (ages 9-12)*Single mom	0.0668		-0.3826		-3.6872***	
Mom worked (age 14)*Single mom	3.0726***		4.0231***		4.1715***	
Mom worked part-time (ages 9-12)*Single mom		0.0292		-4.0657***		-3.6262***
Mom worked full-time (ages 9-12)*Single mom		0.1832		-4.1938***		-3.7841***
Mom worked part-time (age 14)*Single mom		4.6899***		9.0967***		(omitted)
Mom worked full-time (age 14)*Single mom		-0.7467***		4.0410***		4.1402***
Dad worked (age 14)	-0.3300**		-0.2340**		-0.0388	
Dad worked part-time (age 14)		-0.3652		-0.3680**		-0.2454
Dad worked full-time (age 14)		-0.2827**		-0.2248**		-0.0266
Number of children	-0.0100	-0.0238	-0.1076***	-0.1140***	-0.2039***	-0.2012***
Firstborn child	0.0815	0.0992	0.0636	0.0770	0.0794	0.0827
Male child with elder sister(s)	-0.1529	-0.1274	-0.0862	-0.0752	-0.0191	-0.0183
Female child	-0.1047	-0.1245	-0.0620	-0.0607	-0.0362	-0.0208
Healthy child	0.2522***	0.2684***	0.1637***	0.1653***	0.1025	0.1071
Household income (NT\$10,000)	0.0168*	0.0214**	0.0127**	0.0142**	0.0122	0.0111
Homeowner	0.2368***	0.1888**	0.2342***	0.2232***	0.2393***	0.2419***
Dad college educated	0.1769*	0.1597	0.2934***	0.2790***	0.3824***	0.3828***
Mom college educated	0.3666***	0.3682***	0.2934***	0.3050***	0.2276*	0.2364*
Advance maternal age	0.3393	0.3222	0.1790	0.1891	-4.8251***	-4.7902***
Older parent	-0.1236	-0.0815	-0.1172	-0.1048	-0.1317	-0.1105
ln(median income of county/city)	0.5371*	0.4950*	0.2473	0.2439	-0.0409	-0.0390
Metropolitan areas	-0.0891	-0.1015	-0.0010	-0.0097	0.0829	0.0837
$\theta_1$	8.5031**	7.9421**	4.3679*	4.3166*	0.4436	0.4895
$\theta_2$	8.5535**	7.9929**	4.4113*	4.3602*	0.4813	0.5273
$\theta_3$	8.8551**	8.2983**	4.7789*	4.7298*	0.9236	0.9700
Observations	1,435	1,435	3,142	3,142	1,707	1,707

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1



**Table 8.** Ordered Probit Models of High School Attended: Dynamic Patterns of Maternal Employment

VARIABLES	(1)	(2)
Falling maternal employment	0.5210***	0.4942***
Rising maternal employment	0.2255	0.2478*
Persistent maternal employment: part-time	0.2149	0.1549
Persistent maternal employment: full-time	0.2175	0.2822*
Mom worked (age 14)	-0.0932	
Mom worked part-time (age 14)		0.1084
Mom worked full-time (age 14)		-0.1773
Single mom	-3.3968***	-3.4519***
Falling maternal employment*Single mom	-0.9591***	-0.8643***
Rising maternal employment*Single mom	-4.7338***	-0.2913
Persistent maternal employment: part-time*Single mom	-0.1619	-0.2735
Persistent maternal employment: full-time*Single mom	-4.6508***	-0.1034
Mom worked (age 14)*Single mom	3.7946***	
Mom worked part-time (age 14)*Single mom		4.7039***
Mom worked full-time (age 14)*Single mom		-0.6659**
Dad worked (age 14)	-0.3329**	
Dad worked part-time (age 14)		-0.3431
Dad worked full-time (age 14)		-0.2857**
Number of children	-0.0158	-0.0266
Firstborn child	0.0725	0.0928
Male child with elder sister(s)	-0.1181	-0.0945
Female child	-0.1238	-0.1354
Healthy child	0.2549***	0.2581***
Household income (NT\$10,000)	0.0180*	0.0218**
Homeowner	0.2588***	0.2318**
Dad college educated	0.1521	0.1333
Mom college educated	0.3548***	0.3533***
Advance maternal age	0.2922	0.3175
Older parent	-0.1398	-0.1090
ln(median income of county/city)	0.5678*	0.5458*
Metropolitan areas	-0.0824	-0.0967
$\theta_1$	9.0112**	8.7301**
$\theta_2$	9.0609**	8.7801**
$\theta_3$	9.3653**	9.0871**
Observations	1,456	1,456

Source: PSFD (Chu et al., 1999-), 1999-2018 with authors' calculations.

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

110年度專題研究計畫成果彙整表

計畫主持人：王惠貞		計畫編號：110-2629-H-007-002-				
計畫名稱：女性勞動供給動態選擇與家庭產出之分析：以子女成就為例						
成果項目		量化	單位	質化 (說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等)		
國內	學術性論文	期刊論文	0	篇	1. "The Reward of Being a Stay-At-Home Mom: The Dynamics of Maternal Labor Supply and Child Achievement," with Ming-Feng Hsieh. Presented at the 2022 Taiwan Economic Association Annual Conference (Taipei, Taiwan) on December 3rd, 2022. 2. "The Reward of Being a Stay-At-Home Mom: The Dynamics of Maternal Labor Supply and Child Achievement," with Ming-Feng Hsieh. Presented at the International Conference on Continuity and Changes in Families in East Asia (Taipei, Taiwan) on March 25th, 2023.	
		研討會論文	2			
		專書	0			本
		專書論文	0			章
		技術報告	0			篇
		其他	0			篇
		其他	0			篇
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		研討會論文	0			
		專書	0			本
		專書論文	0			章
		技術報告	0			篇
		其他	0			篇
參與計畫人力	本國籍	大專生	0	人次	陳忠新 方子瑜	
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		博士生	0			
		博士級研究人員	0			
		專任人員	0			
	非本國籍	大專生	0			
		碩士生	0			

	博士生	0	
	博士級研究人員	0	
	專任人員	0	
<p style="text-align: center;">其他成果</p> <p>(無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)</p>			