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IZA DP No. 12958

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ABSTRACT

Hope for the Family: The Effects of College Costs on Maternal Labor Supply*

We examine the effects of college costs on the labor supply of mothers. Exploiting changes in college costs after the roll-out of nine generous state merit aid programs from 1993 to 2004, we analyze the difference in the labor supply of mothers before and after these programs were implemented. Mothers of college-age children decreased their annual hours of work after the start of a generous merit aid program, while fathers did not adjust their labor supply. There is no strong evidence that mothers changed their employment status, as most of the decrease in hours of work happened among employed mothers. Mothers of college-going children are entirely responsible for the decline in hours of work, where mothers of children who did not go to college experienced no change in hours of work. A 10 percent increase in spending on merit aid programs per undergraduate student leads to a 1.3 percent decline in hours of work among mothers of college-going children. The decline in labor supply is mainly due to adjustments among married, highly educated, and white mothers.

JEL Classification: I22, J22, J13

Keywords: college costs, maternal labor supply, state merit aid programs

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College costs have been rising over the past few decades: published tuition and fees at public four-year universities rose by about 200 percent from 1989 to 2019 (College Board 2019). Parental income is a primary source of funding for children's college expenses, as parents often support their adult children by subsidizing their living and educational expenses.[1] As a result, college is a major expense for many families: the average in-state tuition net of aid at a public four-year institution is about 26 percent of the income of a median household with a child in college (Radwin and Wei 2015). Thus, it is no surprise that college affordability has been gaining importance in political and policy discussions.[2] Although economists have long studied the effects of college costs on students (Kane 2006, and Page and Scott-Clayton 2016), their potential effects on parental labor supply have been mostly ignored.

The limited evidence on the relationship between college expenses and parental economic outcomes is correlational. Causal inference is difficult because it is challenging to find exogenous changes in college expenses. Handwerker (2011) shows that parents are more likely to be working while they are paying for a child's college education. Faber and Rich (2018) find that increasing rates of college attendance predict increases in foreclosure rates in subsequent years. Finally, several papers documented that financial aid based on assets is connected with lower savings rates (Feldstein 1995, Edlin 1993, Dick and Edlin 1997, and Long 2003).[3] Although these findings suggest a connection between college costs and parental economic outcomes, they mostly present correlations that may be biased because of endogeneity concerns.

This study takes advantage of the state roll-out of nine generous merit aid programs from

[1] In 2018, parents paid on average 49 percent of college costs; students paid 26 percent, while scholarships paid 25 percent of college costs at four-year institutions (Sallie Mae 2018).
[2] See Baum and Turner (2019), Harris (2019), and Chingos and Blagg (2019).
[3] Ding, Lugauer and Bollinger (2019) link increases in the probability of going to college with increases in household savings rates in China.

1993 to 2004 to causally estimate the effect of reduced college costs on parental employment, focusing on maternal labor supply decisions. Since the early 1990s, many states have established state-sponsored merit aid programs for young residents who have maintained a modest grade point average in high school and enrolled in a post-secondary institution in their state of residence. For instance, the Georgia HOPE scholarship covers on average 84 percent of tuition receipts for students enrolled at university-system institutions, with 36 percent of the in-state undergraduate students in those institutions receiving the award in the 2015–2016 school year (Suggs 2016).

We exploit the variation in the years the nine generous merit aid programs were established, using an event-study and instrumental variables framework to estimate their effects on the labor supply decisions of mothers and fathers who could have an eligible child. We pool data from the Panel Study of Income Dynamics (PSID) using years 1988 to 2015; its unique structure allows us to construct samples of parents with college-age and college-going children. We construct merit grant aid per full-time-equivalent student using information on non-need based grant aid spending from the annual reports of the National Association of State Student Grant and Aid Programs (NASSGAP) and undergraduate student enrollment from the Integrated Postsecondary Education Data System (IPEDS). We focus on parents with a potential eligible child by performing the analysis on two samples: (1) parents with any children ages 18 to 22 (we call these "college-age children"), and among those (2) parents with college-going children. Finally, we perform placebo tests and do not find effects for the sample of parents without college-going children.

We find that merit aid resulted in a decline in hours of work among mothers but no adjustment among fathers. These results are consistent with leisure being a normal good, leading workers to withdraw from the labor force as a response to increases in disposable income (Blundell and MaCurdy 1999), and with evidence that female labor supply is historically more elastic than

male labor supply (Bargain and Peichl 2016).[4] The decline in hours of work was mostly due to adjustments at the intensive margin, because we find little evidence of adjustments in the employment status of mothers. We find that the decline in hours of work was entirely due to adjustments among women with college-going children. Our event-study specifications that compare mothers of college-going children before and after merit aid start show that employed mothers of college-going children decreased their hours of work by 210.9 hours, representing a 10.8 percent decline. Our instrumental variables specification finds that a 10 percent increase in spending per undergraduate student in established merit aid programs would lead to a 0.95 percent reduction in hours of work among employed mothers of college-going children. Finally, we find that most of the adjustment in employment outcomes stemmed from more advantaged women: women who are married, highly educated, and white. This is consistent with literature showing that merit aid programs subsidize many students who would have gone to college anyway (Cornwell, Mustard, and Sridhar, 2006, Fitzpatrick and Jones, 2016)[5] and with the fact that less advantaged children are less likely to rely on merit aid and receive other forms of financial aid, such as Pell grants.

In this paper, we estimate the effect of college costs for both mothers of college-age children and mothers of college-going children. One potential concern is that the composition of the sample of mothers of college-going children might change after the implementation of merit aid if these programs affect college enrollment. Results from previous literature are mixed regarding this issue. While Dynarski (2004), and Cornwell, Mustard, and Sridhar (2006) find modest positive effects on college enrollment, Goodman (2008) finds no effects. In addition,

[4] Heim (2007) and Blau and Kahn (2007) show that married women's wage elasticities have declined over time in the United States.

[5] Merit aid may also lead to an increase in the consumption of superfluous goods such as expensive cars and alcohol (Cornwell and Mustard 2007, Cowan and White 2015).

Dynarski (2008) and Scott-Clayton (2011) find positive effects of merit aid programs on college completion, while Fitzpatrick and Jones (2016) and Sjoquist and Winters (2015b) find null effects. Although in our sample we find no evidence that merit aid affected college-going or the composition of mothers of college-going children, the results for mothers of college-going children should be interpreted with this potential caveat.

To conclude, this study provides insights on the family welfare effects of policies that make college more affordable. The study sheds light on an unintended consequence of such policies: a reduction in the labor supply among more advantaged women. Another contribution of this study is the identification of a previously unexplored determinant of maternal labor supply—costs of adult children. Although the costs of young children have substantial effects on maternal labor supply, little is known about how costs of adult children determine maternal employment outcomes.[6] We investigate the effects of college costs, but a similar framework might apply to other financial obligations, such as a down payment on a house, wedding expenses, or co-residence.

I. Background of Merit Aid Programs and Parental Labor Supply

A. Establishment of Merit Aid Programs

Since the early 1990s, many states have established broad-based merit aid programs. The typical program, such as Georgia's HOPE Scholarship, awards tuition and fees to young residents who have maintained a modest grade point average in high school. Some programs also have thresholds for students' SAT or ACT scores or class rank. Many require a high school grade point average (GPA) of 3.0 or above, which is not a particularly high threshold. Many state merit aid programs also require students to maintain a certain GPA in college to renew the award for

[6] For subsidized kindergartens, see Gelbach (2002) and Cascio (2009); for income transfers see Gonzalez (2013) and Schirle (2015).

subsequent years, although the required GPA may differ across states. There is generally no means test for eligibility, and award amounts do not differ by family income.[7] Among many goals, these programs aim to improve the quality of education in the state by providing an incentive for students to perform better in high school and college. They also encourage high-achieving high school students to attend college in-state. Finally, state merit aid programs could offer low-income, high-achieving students who would not otherwise be able to afford college the opportunity to enroll in post-secondary institutions (Barlament 2019).

Following the literature on merit aid programs, in Table 1 we classify nine programs as "strong" due to their significantly larger participation rates and larger average awards (Sjoquist and Winters 2015).[8] Strong merit aid states are heavily concentrated in the southern region of the United States, with seven out of nine states located in the South. Lottery sales (e.g., in Georgia and Kentucky) and tobacco settlements (e.g., in Nevada) are the most common funding sources for merit aid programs. Appendix figure A1 shows that spending on merit aid programs grew in their early years, due to a rise in the share of eligible students, but it tapered off as they became more established. The most generous programs are in Georgia and South Carolina, where states spend on average more than $2,500 per full-time-equivalent (FTE) undergraduate student. Kentucky has the most eligible students, where 34 percent of undergraduates received merit aid in 2012. Finally, the Louisiana TOPS scholarship offers the most generous package, with the maximum aid covering more than 110 percent of the average costs of a public four-year institution in the state. [9]

[7] The Georgia HOPE program had a household income cap of $66,000 in the first year of existence. This cap was raised to $100,000 the following year and eliminated entirely thereafter.
[8] Note that this paper corrects the start date to be 2004 in Tennessee.
[9] The average state merit grant aid per full-time-equivalent undergraduate student comes from the annual reports of the National Association of State Student Grant & Aid Programs (NASSGAP) and the Integrated Postsecondary Education Data System (IPEDS). The percentage of undergraduate students receiving merit aid and the maximum merit aid as a percent of tuition and fees in public four-year institutions is from Frisvold and Pitts (2018). See section II for definitions.

B. Previous Evidence on Effect of Merit Aid on Student Outcomes

Many studies have estimated the effects of merit aid programs on students' educational outcomes. The literature has mixed findings on the effect of merit aid programs on college enrollment and college attainment. Previous literature finds modest positive effects (Dynarski 2004, Cornwell, Mustard, and Sridhar 2006) or no effects (Goodman 2008) on college enrollment and positive effects (Dynarski 2008, Scott-Clayton 2011) or no effects on college completion (Fitzpatrick and Jones 2016, Sjoquist and Winters 2015b). In addition, some papers find evidence that merit aid programs improve college readiness (Pallais 2009, Castleman 2014).

What types of students are eligible for merit aid? Minority and low-income students are disproportionally less likely to be eligible for state merit programs (Dynarski 2004, Farrell 2004, Heller and Rasmussen 2002, Ness and Noland, 2007). As a result, merit aid programs subsidize many students who would have gone to college anyway (Cornwell, Mustard, and Sridhar 2006, Fitzpatrick and Jones, 2016) and lead to an increase in the consumption of superfluous goods such as expensive cars and alcohol (Cornwell and Mustard 2007, Cowan and White 2015).

Finally, the literature has also examined the effect of merit aid on employment and mobility outcomes of students. Frisvold and Pitts (2018) show that merit aid decreases teenage labor force participation, while Barr (2016) shows that merit aid decreases the probability that a male enlists in the military. Zhang and Ness (2010) and Sjoquist and Winters (2014) show evidence that merit aid decreases the "brain drain" resulting from the migration of talented students and workers to other states, although the retention effects are fairly small. After college, Scott-Clayton and Zafar (2017) find that merit aid recipients are more likely to own a home, and less likely to have adverse credit outcomes.

II. Data

This research requires us to match parents to children to be able to construct samples of parents with college-age and college-going children. The principal data source for this study is the Panel Study of Income Dynamics (PSID), because it allows us to construct samples of parents with college-age and college-going children (children who are both college-age and enrolled in college) and identifies parents' state of residence. Specifically, the PSID allows us to match children to their parents regardless of where the children reside. The PSID is a longitudinal survey launched in 1968 with a nationally representative sample, interviewed annually from 1968 to 1997, and every other year thereafter. We pool data from the 1988 to 2015 PSID waves for our analysis.[10] We also use parents' state of residence to identify whether they lived in a state with a strong merit aid program. We use the birth years of each child from the "Childbirth and Adoption History" supplement to construct our sample of parents who have any college-age children (ages 18 to 22).

We examine three main labor market outcomes for parents: annual hours of work, employment status, and annual hours of work if employed. All of these variables are measured as of last year, which leads us to adjust all other variables in our analysis accordingly. For instance, a parent with a child age 18 to 22 in the year when employment outcomes are observed has a child age 19 to 23 in the PSID survey year.[11] We construct the employment status variable using annual hours of work in the past calendar year.[12] We restrict our sample to heads of household or spouses, because we have employment data for this group.

Unfortunately, the PSID does not provide a direct measure of college attendance that is available for everyone in our sample of years. As a result, we define college attendance by

[10] We have data for: 1988-1997 in every year, and 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, and 2015.
[11] However, marital status, household headship, and state of residence are measured as of the current year, because for half of our period of interest, individuals are observed every other year.
[12] A person is employed if he works at least 52 hours a year.

combining several variables, following an approach similar to Lovenheim (2011) and based on correspondence with experts at the PSID.[13] Details on the construction of this variable are in appendix B. Because we are often unable to measure college attendance due to missing information on the child whose parent is present in a particular year, we define a child as college-going if we observe the child enrolled in college anytime within the age range of 18 to 22. To address these issues, we define a parent with a college-going child as a parent with an 18-to 22-year-old child who has ever had any child attend college. A parent without a college-going child is a parent with an 18- to 22-year-old child who has never had any child attend college.

Table 2 shows the summary statistics of our sample of mothers and fathers with college-age children and mothers of college-going and not college-going children. Mothers of college-age children (panel A) are less likely than fathers to be employed, are working fewer hours, are less likely to be white, and are less educated. Mothers are on average 46.9 years old and fathers are 49—therefore, still far from approaching retirement age. Parents in our sample have on average three children. Mothers of college-going children are more likely to be employed and work more hours; be white, older, more educated, and married; and have fewer children.

Our analysis focuses on nine generous merit aid programs (we call these "strong") where both a substantial share of students were eligible and a significant share of tuition and fees was covered by aid (Sjoquist and Winters 2015).[14] In table 1 we use three state-level variables to describe the intensity of merit aid programs: state merit grant aid per full-time-equivalent (FTE) undergraduate student; percentage of undergraduate students receiving merit aid and the maximum

[13] We use the completed education, employment status, whether student, last year in school variables from the PSID, and the college attendance variable from the Transition to Adulthood Supplement.

[14] Arkansas introduced a strong merit aid program in 2010. Because the introduction of this state would restrict our analysis to a much shorter post-merit-aid period, we exclude any observations for parents in Arkansas from our sample.

merit aid as a percentage of tuition and fees in public four-year institutions.[15] To construct merit grant aid per FTE undergraduate student, we use the information on non-need-based grant aid awarded to undergraduate students from the annual reports of the National Association of State Student Grant & Aid Programs (NASSGAP) and FTE undergraduate student enrollment by state from the Integrated Postsecondary Education Data System (IPEDS).

III. Effect of Introducing Merit Aid Programs: Event-Study Framework

A. Event-Study Regression Framework

To estimate the effect of merit aid programs, we exploit their roll-out in nine states with strong merit aid programs from 1993 to 2004 within an event-study framework (Jacobson, LaLonde and Sullivan 1993).[16] The following specification allows us to estimate the aggregate effect of merit aid on parental outcomes:

$$Y_{i,s,t} = \alpha + \gamma_t + \delta_s + \sum_{\tau=-3}^{-1} \theta_\tau D_s 1(EY = \tau) + \sum_{\tau=1}^{7} \pi_\tau D_s 1(EY = \tau) + X_{s,t} + Z_{i,t} + C_{s,t} + \epsilon_{i,s,t} \quad (1)$$

where $Y_{i,s,t}$ is an employment outcome of parent *i* residing in state *s* in year *t* who has a college-age child in year *t*; γ_t are year fixed effects; δ_s are state fixed effects; and D_s is a dummy that equals one if a state has a strong merit aid program. Because PSID was done once every two years after 1997, we construct grouped event years, *EY*, to keep our sample of states balanced within each grouped event year.[17] Thus, $1(EY = \tau)$ is a dummy that represents grouped event years, or grouped years relative to the start of merit aid within a state.[18] The grouped event years, *EY*, range from -2 to 6 for a balanced set of states, where *EY* = 1 represents 0 to 1 years, *EY* = 2 represents 2 to 3 years, *EY* = 3 represents 4 to 5 years, *EY* = 4 represents 6 to 7 years, *EY* = 5 represents 8 to 9

[15] Data on the share of students receiving aid and maximum benefits are from Frisvold and Pitts (2018).
[16] See table 1 for a list of states with strong merit aid programs.
[17] For instance, not all states are observed in the PSID 2 years after merit aid started, but all states are observed 2 to 3 years after merit aid started.
[18] An event year is the year of observation minus the year of merit aid program start.

years, and $EY = 6$ represents 10 to 11 years after merit aid started; while EY = -1 represents 3 to 4 years and EY = -2 represents 5 to 6 years before merit aid started. We only present results for a balanced set of grouped event years, but all event years are included in the regression.[19] Note that EY = 0 is omitted, representing 1 to 2 years before merit aid started. We expect that merit aid programs may have effects on parental employment in the year of the program start (or 0 years since the start of the program), because parents may adjust their labor supply as soon as they find out that their child is eligible for merit aid. Finally, all the states that did not implement the program are represented with $EY = 0$ in the regression equation.

In addition, the equation includes individual-level covariates, $Z_{i,t}$: whether the parent is white, years of education fixed effects, age fixed effects, marital status fixed effects, number of children, and household headship. It also includes state by year educational controls, $C_{s,t}$: need-based aid spending to undergraduate students per full-time-equivalent enrolled undergraduate student from NASSGAP and IPEDS, average tuition and fees for full-time undergraduates separately in public four-year and two-year degree institutions. These covariates control for other state-level higher education policy changes that might happen during the introduction of a state merit aid program. The equation also includes state-level economic co-variates from the University of Kentucky Center for Poverty Research, $X_{s,t}$, including the unemployment rate, log state government revenue, minimum wage, whether the governor is a democrat, the poverty rate, number of AFDC/TANF recipients, and number of food stamp/SNAP recipients. These covariates control for changes in the economy and political environment that could be potentially correlated to the introduction of merit aid programs. We also present robustness checks of the paper's main

[19] We also group values of event years that are not based on a balanced set of states: values of $\tau < -2$ to be equal to -3 and values of $\tau > 6$ to be equal to 7.

findings, where we do not control for individual and state-level characteristics. We cluster standard errors at the state level to account for potential spatial correlation within a state and weight using the individual longitudinal weights.

Our coefficient of interest is π_τ, which measures the effect of merit aid on outcomes of families with college age children τ grouped years after the start of merit aid. Because we do not restrict the sample to families receiving merit aid, the coefficient should be interpreted as an intent to treat effect. Our figures and tables only present estimates for years that include a balanced set of states, representing grouped event years -2 to 6 (or event years -6 to 11). Estimates of θ describe the differential evolution of outcomes in states with strong merit aid programs before these programs started. They document if pre-existing trends bias estimates of π and if "effects" preceded the program.

After presenting results in an event-study framework, we also summarize our results in a difference-in-differences specification. The grouped event year dummies, $1(EY = \tau)$, are replaced with dummies for grouped event years -3 and below ($1(EY \leq -3)$), 1 to 6 ($1(1 \leq EY \leq 6)$), and 7 and above ($1(EY \geq 7)$).[20] The coefficient on the dummy for grouped event years 1 to 6 measures the average effect over the twelve years merit aid programs have been in place.

B. Testing the Internal Validity of the Regression Framework

We provide both institutional and empirical evidence supporting the assumption in our event study strategy that the year of merit aid start is conditionally random. First, institutional details support this assumption. The merit aid literature agrees that states were mostly experimenting with a new higher education policy rather than responding to economic or educational shocks (Dynarski 2004). Governor Zell Miller introduced the Georgia HOPE program

[20] Note that coefficients for dummies of grouped event years -3 and below, as well as 7 and above, are based on an unbalanced set of states, so we do not display those coefficients in tables.

as a visionary act to promote higher education, which set an example that many other states have followed. In addition, lottery sales revenues and the proceeds from tobacco settlements are among the most common sources of funding for these programs (Heller and Marin 2004). Lottery sales and tobacco settlements revenues are less likely to be affected by economic and political changes within a state.

Empirical evidence supports that the timing of merit aid programs was conditionally random in three ways. First, we show that there is no relationship between employment outcomes before merit aid programs started and the year a program started. Table A1 shows small and statistically insignificant coefficients on the relationship between the year of merit aid start and employment outcomes of women ages 35 to 64 who have children before the start of merit aid programs.[21] Second, in the next section we show no evidence of pre-trends of maternal employment outcomes in the years before the introduction of a merit aid program. Third, the inclusion of educational, economic, and political controls does not affect our results (Altonji, Conley, Elder, and Taber 2019). Finally, we conduct a placebo test on mothers of not college-going children, and do not find evidence that they decreased their labor supply after merit aid programs started.

C. Results: Effect of Merit Aid on Hours of Work of Parents of College-age Children

Figure 1 displays event-study estimates of the effects of merit aid programs on hours of work of mothers and fathers of college-age children. It presents estimates of our preferred model that includes the full set of covariates listed in equation (1). Estimates to the left of the vertical axis present grouped years before merit aid started, and estimates to the right of the vertical axis present

[21] This analysis is done using PSID years 1989 to 1992.

grouped years after merit aid started, where each grouped event year actually includes two years.[22] Thus, the graph extends to 6 years before and 11 years after merit aid started. Dashed lines plot 95-percent, point-wise confidence intervals in our preferred model. Table A3 (column 4) presents the point estimates, while table 3 summarizes the estimates in figure 1 in a difference-in-differences specification and presents the overall effect over 12 years after implementation.[23]

Panel A of figure 1 shows that mothers of college-aged children worked significantly fewer hours after merit aid started. The sample for this panel includes both women who are employed and unemployed, where annual hours of work equal zero for women who did not work. However, before merit aid programs the work hours of women were stable, evidenced by small and statistically insignificant coefficients on negative grouped event years. The effect of merit aid appears in a notable drop in coefficients, evidenced by negative and statistically significant coefficients on positive grouped event years. Table 3 (panel A) shows that hours of work dropped by 194 hours per year, representing a 12.4 percent decline. Table 3 and table A3 show the robustness of these estimates to the addition of different control variables. Column 1 includes state and year fixed effects, column 2 adds individual-level covariates, column 3 adds educational covariates at the state and year level, and column 4 adds macroeconomic covariates at the state and year level. The coefficients across specifications are similar; thus, all our results are robust to the inclusion of covariates.

There is no evidence that fathers have changed their work hours after merit aid. Panel B of figure 1 shows small and statistically insignificant coefficients before and after merit aid started. This result is consistent with the literature finding that historically female labor supply elasticities

[22] Grouped event years and their corresponding years since merit aid programs in parentheses: -2 (-5 and -6), -1 (-4 and -3), 1 (0 and 1), 2 (2 and 3), 3 (4 and 5), 4 (6 and 7), 5 (8 and 9), 6 (10 and 11).
[23] Tables A3 to A8 (column 4) show the point estimates and standard errors corresponding to figures 1, 2, and 3.

are larger than male elasticities (Bargain and Peichl 2016). Given the null effect on fathers, the rest of the paper focuses on mothers.

D. Results: Intensive or Extensive Margin Effects?

Next, we examine whether the maternal decrease in hours of work was a result of exit from the labor market (extensive margin adjustment) or a decline in hours of work among mothers who were employed (intensive margin adjustment). For the extensive margin adjustment, we examine the change in employment status, while for the intensive margin adjustment we examine the change in hours of work for employed mothers.

The decline in hours of work was mostly a result of adjustment on the intensive margin. Figure 2 panel A mostly shows no evidence of a change in employment status, which is supported by a small and statistically insignificant change in table 3 (panel B, column 4). The coefficient is negative and statistically significant for mothers of college-age children 9 to 10 years after merit aid started, which may mean that mothers started also adjusting their employment status after some time passed from first establishment of merit aid programs. However, the overall pattern of coefficients, their small magnitudes, and their large standard errors mostly point to a lack of convincing evidence for a significant effect on employment status. Figure 2, panel B, shows a drop in hours of work among employed mothers after merit aid started, providing evidence for an intensive-margin adjustment. Table 3 (panel C) shows that employed mothers of college-age children dropped their hours of work by 174.8 hours, representing a 9.1 percent decline.

E. Results: Effect of Merit Aid Programs on Mothers' Labor Supply by College-going Status of Children

Are the declines in hours of work focused among mothers of children who likely receive merit aid? To answer this question, we conduct the analysis by the college-going status of the

child. Only parents who have college-going children can receive merit aid. Thus, we do not expect parents without college-going children to adjust their labor supply.

One potential concern is that merit aid programs also affected the college-going decision, which may affect labor supply mechanically through the change in the composition of parents of college-going children. In fact, previous papers (Cornwell et al. 2006) have estimated a small (about 6 percent) increase in college attendance as a result of merit aid programs. To evaluate this issue, we test whether parents of college-going children are systematically different after merit aid. Panel A of appendix table A2 finds no evidence that mothers have college-age children who change their college-going behavior, evidenced by a small and statistically insignificant coefficient in column (1). Moreover, table A2 finds no statistically significant evidence that mothers of college-age (panel A), college-going (panel B), and non-college-going (panel C) children are different in terms of their years of education, race, number of children, and age after the start of merit aid. Given that the effect of these programs on college attendance and parent composition is small enough that it is undetectable in the PSID, any bias from the endogeneity of college attendance is likely very small.

As expected, the decline in hours of work was due to adjustments among mothers who have college-going children. Panel A of figure 3 shows a notable decline in hours of work after merit aid programs started among mothers of college-going children. Table 4 (panel A) shows that annual hours of work dropped by 269.3 hours over 12 years after the start of merit aid programs among mothers of college-going children. Results in panel B of figure 3 provide further evidence of the validity of our estimation strategy. These results show no evidence of a change in hours of work among mothers who didn't have a child attending college.

Similar to the sample of mothers of college-age children, the decline in hours work happened at the intensive margin for mothers of college-going children. Table 4 (panel B) shows a small and insignificant drop in the probability of employment. Among employed mothers of college-going children, annual hours of work fell by 210.9 hours over 12 years after the start of merit aid programs, representing a 10.8 percent decrease.

IV. Effect of Spending on Merit Aid Programs on Employment: Panel Instrumental Variables Framework

A. Panel Instrumental Variables Regression Framework

Next, we turn to estimating the relationship between spending on merit aid programs and maternal labor supply. To address concerns about the endogeneity of merit aid spending, we instrument for changes in merit aid spending using the introduction of merit aid programs.[24] We model the change in merit aid spending using an indicator for a strong state interacted with an indicator for the year of merit aid program start in each state. The first-stage regression in this two-stage least squares (2SLS) estimator is a difference-in-differences regression model:

$$Merit_{i,s,t} = \alpha_1 + \alpha_2 * D_s * 1(EY \geq 1) + \gamma_t + \delta_s + X_{s,t} + Z_{i,t} + C_{s,t} + \epsilon_{i,s,t}, \quad (2)$$

where $Merit_{i,s,t}$ is merit aid spending per undergraduate full-time-equivalent (FTE) undergraduate student in individual *i*'s state of residence *s* and year *t*, $D_s * 1(EY \geq 1)$, is the instrumental variable equal to 1 in strong states ($D_s = 1$) in years after merit aid start ($1(EY \geq 1)$), and 0 in strong states in years before merit aid start and in states without strong merit aid programs. Other controls are the same as in our baseline event-study model (1). The coefficient of interest is α_2, providing an estimate of the effect of the introduction of merit aid on spending in the years after the introduction.

[24] Isen, Rossin-Slater, and Walker (2017) use a similar instrumental variable approach to estimate impacts of early childhood exposure to air pollution on adult outcomes.

The second stage uses the predicted merit aid spending from equation (2):

$$Y_{i,s,t} = \alpha + \beta \widehat{Merit}_{\iota,s,t} + \gamma_t + \delta_s + X_{s,t} + Z_{i,t} + C_{s,t} + \epsilon_{i,s,t}, \quad (3)$$

The coefficient of interest, β, shows the effect of a one-dollar increase in merit aid spending per undergraduate student driven by the start of merit aid programs on the labor supply of mothers who have college-age children, $Y_{i,s,t}$.

Several pieces of evidence support the excludability condition of our instrument required for a consistent estimate of β. Note that the excludability condition is equivalent to assumptions necessary for internal validity of the event-study research design in section III. First, estimates in figures 1, 2, and 3 (section III) showed no pre-trend in employment outcomes before merit aid programs started, supporting the claim that merit aid programs were not implemented in response to differential trends in employment outcomes. Second, table A1 and anecdotal evidence of details of program implementation provided evidence that the timing of merit aid programs was conditionally random. Third, table A2 provided evidence that the composition of mothers of college-age and college-going children did not change after merit aid programs.

B. Results: Effect of Merit-Aid Spending on Maternal Labor Supply

First, we present evidence for the first-stage relationship between merit aid start and spending. The estimates in appendix table A9 correspond to estimates of α_2 in equation (2) and support a strong relationship between merit aid start and merit aid spending across different specifications. In the sample of mothers with a college-age child, merit aid start corresponded to an average $1,094 increase in merit aid spending per full-time equivalent undergraduate student over 12 years after merit aid start, while in the sample of mothers with a college-going child,

merit aid start corresponded to an average $1,125 increase in merit aid spending per full-time equivalent undergraduate student.[25]

The instrumental variable specification shows that merit aid spending is associated with decreases in maternal labor supply. Table 5 presents estimates from equation (3) among mothers of college-age children. A $1 increase in merit aid spending per undergraduate student leads to a reduction of 0.146 (panel A, column 4) hours of work among mothers of college-age children. Thus, a 10 percent increase in spending per undergraduate student ($109.4 = 0.1*$1,094) leads to a 1 percent decline in hours of work (-0.146*109.4/1,567).[26]

Consistent with results from the event-study specification, most of the adjustment in hours of work is a result of adjustments at the intensive margin. The coefficients in Table 5 (panel B) on the employment status are small and statistically insignificant, where most of the adjustment in hours of work came from already-employed individuals. A 10 percent increase in spending per undergraduate student leads to a 0.85 percent decline in hours of work (-0.131*109.4/1,567).

Consistent with results from the event-study specification, the decline in hours of work is entirely due to adjustments among mothers of college-going children. Table 6 presents estimates from equation (3) among mothers of college-going children. A $1 increase in spending per undergraduate student leads to a reduction of 0.199 (panel A, column 4) hours of work among mothers of college-going children. Thus, a 10 percent increase in spending per undergraduate student ($112.5 = 0.1*$1,125) leads to a 1.35 percent decline in hours of work (-

[25] The difference in coefficients is due to differential distributions of mothers of college-age and college-going children in the PSID across states with strong merit aid programs.
[26] The pre-treatment mean hours of work is 1567, as presented in panel A of table 3.

0.199*112.5/1,659). However, appendix table A10 (panel B) shows no evidence of effects of merit aid programs on hours of work among mothers who never had a college-going child.

V. Heterogeneous Effects of Merit Aid Programs

Which mothers of college-going children are more affected by merit aid programs? To answer this question we examine the heterogeneous effects of merit aid for advantaged and disadvantaged mothers. We define advantaged mothers as those who are married, have at least some college education, and are white. We compare the effects of merit aid programs across different groups of mothers: (1) married and single, (2) completed at least some college and completed high school or less, and (3) white and non-white.

It is ambiguous whether advantaged and disadvantaged mothers would adjust their labor supply the most. On one hand, advantaged mothers may adjust their labor supply the most for several reasons. First, the children of advantaged mothers are disproportionately more eligible for merit aid (Dynarski 2004, Farrell 2004, Heller and Rasmussen 2002, Ness and Noland 2007, Zhang and Ness 2010).[27] This is important because the analysis focuses on women with college-going children and not on women whose children receive merit aid. Second, advantaged women have fewer credit constraints, allowing them to lower their labor supply, while less advantaged women may experience changes in their educational debt levels. Third, advantaged women are less likely to be eligible for other forms of financial aid. For disadvantaged mothers, merit aid income may displace other financial aid income, such as Pell grant transfers, resulting in no change in the cost of college (Scott-Clayton 2017).[28] Most disadvantaged students receive enough aid from sources

[27] For instance, table 1 in Ness and Noland (2007) shows that in Florida 23 percent of low-income students and 44 percent of high-income students were eligible in 2003.

[28] However, financial aid transfers may still be lower than the merit aid transfer, because families may still be expected to take out loans in addition to financial aid.

like the Pell grant and state need-based programs to cover their tuition and fees.[29] As a result, disadvantaged mothers would not adjust their labor supply after merit aid, while the advantaged mothers who do not qualify for other financial aid have incentives to adjust their labor supply, because they experience reductions in the cost of college. On the other hand, the opportunity cost of less advantaged mothers is lower due to their lower wages. As a result, they might be more likely to lower their labor supply in response to transfers.

We find that merit-aid-induced adjustments in labor supply are mainly due to married, highly educated, and white mothers. Importantly, these conclusions hold for both mothers of college-age and college-going children. Finally, there is no evidence of a change in the employment status among advantaged and disadvantaged mothers. As a result, most of the adjustment in hours of work stems from employed mothers. Tables 7 and 8 summarize coefficients from the instrumental-variables framework for mothers of college-age children and mothers of college-going children, respectively. These tables present estimates from our preferred specification (model 4) that includes the full set of covariates in equation (3).

First, the decline in hours of work after merit aid started is due to adjustments among married women. We compare labor supply responses of mothers who are listed as heads of households to those who are listed as spouses. If a husband is present in the household, the PSID lists him as the head and his wife/partner as spouse. Thus, a mother who is not listed as the head is almost always married, while a mother who is listed as the head is almost always single.[30] A 10 percent increase in merit aid spending leads to a 1.2 percent (-0.196*0.1*1,093/1,727) decrease in hours of work among married mothers of college-age children (table 7, panel A, column 1). We

[29] In fact, 58 percent of the lowest-income students at four-year universities received enough aid to cover their tuition and fees and pay nothing to attend college (College Board 2018).
[30] Our sample only includes individuals listed as either heads or spouses.

find no evidence of adjustments among unmarried women where the coefficient is small and statistically insignificant (table 7, panel A, column 2).

Second, the decline in hours of work is due to adjustments among highly educated women. We compare labor supply responses among mothers who have completed some college education and mothers who have not. A 10 percent increase in merit aid spending leads to a 1.6 percent (-0.245*0.1*1,094/1671) decline in hours of work among mothers of college-age children (table 7, panel A, column 3). While the coefficient among less educated women is also negative (table 7, panel A, column 4), it is smaller and not statistically significant and smaller still in the sample of mothers of college-going children in table 8 (panel A, column 4).

Third, the decline in hours of work is due to adjustments among white mothers. A 10 percent increase in merit aid spending leads to a 1.6 percent (-0.244*0.1*1,094/1,714) decline in hours of work among mothers of college-age children (table 7, panel A, column 5). We find no evidence of adjustments among non-white mothers where the coefficient is small and statistically insignificant (table 7, panel A, column 6).

VI. Conclusion

College costs represent a major expense for families with a college-going child. State-sponsored merit aid programs make attending college substantially cheaper for these families. While most of the literature has evaluated the impact of such programs on children's outcomes, it has largely ignored their potential effects on parental labor supply. More importantly, as the college-affordability debate is gaining political traction, it is important to evaluate the potential effects of making college more affordable on the whole family.

We find that mothers of college-going children decreased their annual hours of work after the implementation of a merit aid program in their state of residence. This decline is mostly due to

employed mothers reducing their hours of work. A 10 percent increase in merit aid spending per undergraduate student leads to a 1.3 percent reduction in hours of work among mothers of college-going children. Moreover, we find the strongest adjustments in labor supply among more advantaged mothers. This finding is consistent with more advantaged mothers benefiting disproportionately from state merit aid programs (Dynarski 2000), as they are responsible for covering the cost of college for their children in the absence of aid.

Importantly, this study also contributes to the literature on the determinants of female labor supply by offering some insights on the effects of adult child costs on maternal labor supply. While most of the literature has focused on mothers with young children, this paper identifies a novel determinant of female labor supply—costs of adult children.[31] Do we expect women to adjust their labor supply in the same manner in response to changes in costs of adult children relative to changes in costs of younger children? On one hand, the labor supply of women with younger children may be more responsive, because of greater perceived returns to spending time with their children. Mothers may believe that young children benefit the most from interactions with the mother or may be dissatisfied with the available child care options. On the other hand, the labor supply of women with adult children may be more responsive, because they are closer to retirement and face lower penalties for career interruptions than younger women (Miller 2011). Consistent with our findings of effects of adult-children cost reductions, the literature examining effects of income transfers during a child's early years mostly finds reductions in maternal labor supply (Black, Devereux, Løken and Salvanes 2014, Gonzalez 2013, Schirle 2015, Wingender and LaLumia 2017).[32]

[31] For subsidized kindergartens, see Gelbach (2002) and Cascio (2009); for income transfers, see Gonzalez (2013) and Schirle (2015).

[32] Other factors changing costs of children include subsidized child care, parental leave, and contraception. Subsidized kindergartens and public schooling have mostly resulted in substantial increases in female labor supply

To conclude, considering changes in parental employment behavior is important for the discussions about making college more affordable. We find that merit aid programs may unintentionally discourage more advantaged women from working. It is important to remember that merit aid is a transfer that may last a total of four years and may be granted to multiple children. Thus, individuals are likely adjust their labor supply in response to an expected stream of payments and not to a payment in a particular year. As a result, a potential unintended social cost of these programs is a reduction in tax revenue resulting from declines in maternal labor supply, although it also affects family welfare by potentially increasing mothers' leisure time. These insights are important to policymakers, because they may affect state government budgets and family well-being.

(Baker, Gruber and Milligan 2008, Cascio 2009, Gelbach 2002, Havnes and Mogstad 2011, Lefebvre and Merrigan 2008). Shorter extensions in parental leave increased employment of mothers, while longer extensions decreased it (Rossin-Slater 2018). Access to contraception increased female employment (Bailey 2006, Goldin and Katz 2002).

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Table 1. States with Strong Programs Implemented

State	First Year	Program Name	State merit grant aid per full-time-equivalent undergraduate student in 2012	Percentage of undergraduate students receiving merit aid in 2012	Maximum merit aid as percentage of tuition and fees in public four-year institutions in 2012
Florida	1997	Florida Bright Futures Scholarship	$482	18.8	72.0
Georgia	1993	Georgia HOPE Scholarship	$2,538	27.3	73.0
Kentucky	1999	Kentucky Educational Excellence Scholarship	$921	34.1	29.0
Louisiana	1998	Louisiana TOPS Scholarship	$1,616	23.8	112.0
Nevada	2000	Nevada Millennium Scholarship	$375	18.8	42.0
New Mexico	1997	New Mexico Lottery Success Scholarship	$1,364	18.3	80.0
South Carolina	1998	South Carolina LIFE Scholarship	$2,641	21.0	68.0
Tennessee	2004	Tennessee HOPE Scholarship	$1,814	28.5	95.0
West Virginia	2002	West Virginia PROMISE Scholarship	$753	13.2	80.0

Notes: The table presents details on strong merit aid programs in nine states that implemented them between 1993 and 2004. Arkansas started a strong merit aid program in 2010 but is not included in our analysis due to the short length of observation of the post-implementation period in our data. Sources: Sjoquist and Winters (2015a), Frisvold and Pitts (2018), and NASSGAP annual reports and IPEDS.

Table 2. Characteristics of Parents of College-Age Children

	(1)	(2)	(3)	(4)
A. Parents of College-Age Children				
	Mothers		**Fathers**	
Analysis Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Annual Hours of Work	1416	932	2029	905
Employed (%)	80.8	39.4	91.5	27.8
White, non-Hispanic	75.5	43.0	82.9	37.6
Age	46.9	6.0	49.0	6.0
Number of Children	3.0	1.5	2.9	1.5
Some College	42.2	49.4	49.8	50.0
Head	31.8	46.6	100.0	0.0
Observations	13907		9832	

B. Mothers of College-Age Children				
	Children College-Goers		**Children Not College-Goers**	
Analysis Variables	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Annual Hours of Work	1465	908	1337	965
Employed (%)	83.6	37.0	76.0	42.7
White, non-Hispanic	78.2	41.3	70.6	45.6
Age	47.3	5.7	45.7	6.3
Number of Children	2.8	1.4	3.2	1.7
Some College	52.8	49.9	22.6	41.8
Head	24.7	43.1	45.1	49.8
Observations	7890		5162	

Notes: Panel A statistics use a sample of women (columns 1 and 2) and men (columns 3 and 4) with any children ages 18 to 22, which we define as "college-age children." Panel B uses a sample of women with any children ages 18 to 22 who ever had a college-going child (columns 1 and 2, I call these "college-going") and the sample of women with any children ages 18 to 22 who never had a child go to college (columns 3 and 4, we call these "not college-going"). Statistics are weighted by the individual weights provided in the PSID. Source: PSID.

Table 3. Effect of Merit Aid on Employment Outcomes of Mothers with a College-Age Child

	(1)	(2)	(3)	(4)
A. Dependent Variable: Annual Hours of Work				
After Merit Aid	-160.6	-188.2	-186.2	-194.4
	[70.07]**	[76.06]**	[78.75]**	[83.66]**
Observations	13907	13907	13907	13907
Pre-treatment Mean	1567	1567	1567	1567
B. Dependent Variable: Employment Status (percent)				
After Merit Aid	-3.125	-3.771	-3.323	-3.483
	[2.391]	[2.451]	[2.465]	[2.503]
Observations	13907	13907	13907	13907
Pre-treatment Mean	81.49	81.49	81.49	81.49
C. Dependent Variable: Annual Hours of Work if Employed				
After Merit Aid	-128.1	-159.1	-166.2	-174.8
	[68.60]*	[72.19]**	[72.36]**	[80.32]**
Observations	10842	10842	10842	10842
Pre-treatment Mean	1923	1923	1923	1923
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro

Notes: The coefficients show the effect of merit aid programs on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed mothers (panel C) of college-age children over 12 years after the start of merit aid programs. The coefficients come from a difference-in-differences version of equation (1), where the grouped event year dummies are replaced with dummies for grouped event years -3 and below, 1 to 6, and 7 and above. The coefficient on "after merit aid" is the coefficient on the dummy for grouped event years 1 to 6 corresponding to a balanced set of states. The omitted event years are -1 and -2, and observations from states with no merit aid programs are in the omitted group. The sample includes women with a college-age child. Regressions are weighted using individual longitudinal weights. Standard errors are clustered at the state-level and presented in brackets under the coefficients. Column (1) includes state and year fixed effects; column (2) adds individual-level controls: race, education fixed effects, age fixed effects, marital status dummies, number of children, and household headship; column (3) adds state-level education controls: need-based aid spending per full-time equivalent (FTE) student, state average tuition and fees for FTE undergraduates separately in four-year and two-year institutions; column (4) includes state-level macroeconomic controls: the unemployment rate, log state revenue, state minimum wage, whether the governor is a democrat, the poverty rate, number of AFDC/TANF recipients, and number of food stamp/SNAP recipients. The pre-treatment mean is calculated in strong merit aid states in event years -1 and -2. Statistically significant at ***0.01, **0.05, *0.10. Sources: PSID, NASSGAP, IPEDS, University of Kentucky Poverty Center.

Table 4. Effect of Merit Aid on Employment Outcomes of Mothers with a College-Going Child

	(1)	(2)	(3)	(4)
A. Dependent Variable: Annual Hours of Work				
After Merit Aid	-221.2	-244	-248.5	-269.3
	[90.60]**	[90.81]***	[91.83]***	[85.80]***
Observations	7890	7890	7890	7890
Pre-treatment Mean	1659	1659	1659	1659
B. Dependent Variable: Employment Status (percent)				
After Merit Aid	-5.758	-6.024	-5.597	-5.408
	[4.179]	[3.655]	[3.505]	[3.279]
Observations	7890	7890	7890	7890
Pre-treatment Mean	84.94	84.94	84.94	84.94
C. Dependent Variable: Annual Hours of Work if Employed				
After Merit Aid	-134.1	-172.5	-184.4	-210.9
	[92.25]	[94.16]*	[93.70]*	[99.06]**
Observations	6465	6465	6465	6465
Pre-treatment Mean	1953	1953	1953	1953
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro

Notes: The coefficients show the effect of merit aid programs on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed mothers (panel C) of college-going children over 12 years after the start of merit aid programs. See notes and sources for table 3.

Table 5. Effect of Merit Spending per Full-time Equivalent (FTE) Undergraduate Student on Employment Outcomes of Mothers of a College-Age Child

	(1)	(2)	(3)	(4)
A. Dependent Variable: Annual Hours of Work				
Merit spending per FTE student ($)	-0.106	-0.144	-0.150	-0.146
	[0.0687]	[0.0728]**	[0.0777]*	[0.0790]*
Observations	13,907	13,907	13,907	13,907
First-stage F-statistic	14.71	15.03	18.77	18.37
B. Dependent Variable: Employment Status (percent)				
Merit spending per FTE student ($)	-0.00208	-0.00312	-0.00283	-0.00261
	[0.00294]	[0.00284]	[0.00284]	[0.00288]
Observations	13,907	13,907	13,907	13,907
First-stage F-statistic	14.71	15.03	18.77	18.37
C. Dependent Variable: Annual Hours of Work if Employed				
Merit spending per FTE student ($)	-0.0838	-0.119	-0.132	-0.131
	[0.0648]	[0.0695]*	[0.0745]*	[0.0777]*
Observations	10842	10842	10842	10842
First-stage F-statistic	13.49	13.81	16.5	16.16
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro

Notes: The estimates present the effect of merit aid spending per full-time-equivalent undergraduate student (in 2015 dollars) on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed (panel C) mothers of college-age children using an indicator for the period after merit aid introduction in strong states as an instrumental variable. Kleibergen-Paap Wald F-statistics are reported as a test of the first-stage strength of the instrument. Regressions are weighted using longitudinal weights. Standard errors are clustered at the state level and presented in brackets under the coefficients. See table 3 notes for a description of models in columns (1) to (4). Sources: PSID, NASSGAP, IPEDS, University of Kentucky Poverty Center.

Table 6. Effect of Merit Aid Spending per Full-Time-Equivalent Undergraduate Spending on Employment Outcomes of Mothers of a College-Going Child

	(1)	(2)	(3)	(4)
A. Dependent Variable: Annual Hours of Work				
Merit spending per FTE student ($)	-0.161	-0.190	-0.202	-0.199
	[0.0797]**	[0.0848]**	[0.0881]**	[0.0863]**
# Observations	7890	7890	7890	7890
First-stage F-statistic	12.92	13.62	16.34	16.07
B. Dependent Variable: Employment Status (percent)				
Merit spending per FTE student ($)	-0.00424	-0.00506	-0.00491	-0.00421
	[0.00425]	[0.00340]	[0.00328]	[0.00330]
# Observations	7890	7890	7890	7890
First-stage F-statistic	12.92	13.62	16.34	16.07
C. Dependent Variable: Annual Hours of Work if Employed				
Merit spending per FTE student ($)	-0.098	-0.130	-0.144	-0.155
	[0.0900]	[0.0990]	[0.101]	[0.104]
# Observations	6465	6465	6465	6465
First-stage F-statistic	12.46	13.03	15.24	15.06

Notes: The estimates present the effect of merit aid spending per full-time-equivalent undergraduate student on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed (panel C) mothers of college-going children using an indicator for the period after merit aid introduction in strong states as an instrumental variable. See notes for table 5.

Table 7. Heterogeneous Effect of Merit Aid Spending per Full-Time-Equivalent Student on Employment Outcomes of Mothers with a College-Age Child

	(1)	(2)	(3)	(4)	(5)	(6)
	Not Head of Household	**Head of Household**	**Some College**	**High School or Less**	**White**	**Non-white**
A. Dependent Variable: Annual Hours of Work						
Merit per FTE Student	-0.196	-0.0506	-0.245	-0.0995	-0.244	0.020
	[0.106]*	[0.0827]	[0.143]*	[0.100]	[0.134]*	[0.0575]
Observations	7945	5962	5002	8411	6622	7285
Pre-treatment Mean	1727	1260	1671	1539	1714	1174
First-stage F-statistic	18.28	23.18	12.57	27.44	15.41	35.37
B. Dependent Variable: Employment Status (percent)						
Merit per FTE Student	-0.0029	-0.00152	-0.00503	-0.00234	-0.00414	0.00104
	[0.00457]	[0.00329]	[0.00403]	[0.00494]	[0.00468]	[0.00361]
Observations	7945	5962	5002	8411	6622	7285
Pre-treatment Mean	83.35	77.92	84.98	81.19	85.8	69.96
First-stage F-statistic	18.28	23.18	12.57	27.44	15.41	35.37
C. Dependent Variable: Annual Hours of Work if Employed						
Merit per FTE Student	-0.178	-0.0303	-0.195	-0.0793	-0.208	-0.0135
	[0.106]*	[0.0808]	[0.109]*	[0.0761]	[0.117]*	[0.0667]
Observations	6305	4537	4425	6062	5443	5399
Pre-treatment Mean	2072	1617	1967	1896	1998	1678
First-stage F-statistic	16.1	18.76	11.89	22.9	14.41	27.96

Notes: The estimates present the effect of merit aid spending per full-time-equivalent undergraduate student on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed (panel C) mothers of college-age children using an indicator for the period after merit aid introduction in strong states as an instrumental variable. Each column represents a different sample of mothers: column (1) includes mothers who are not listed as head of household (married); column (2) includes mothers who are listed as head of household (unmarried); column (3) includes mothers who have completed some college; column (4) includes mothers who have completed high school or less; column (5) includes white mothers; and column (6) includes non-white mothers. The estimates are from model (4), which is our baseline specification that includes all co-variates. See notes for table 5.

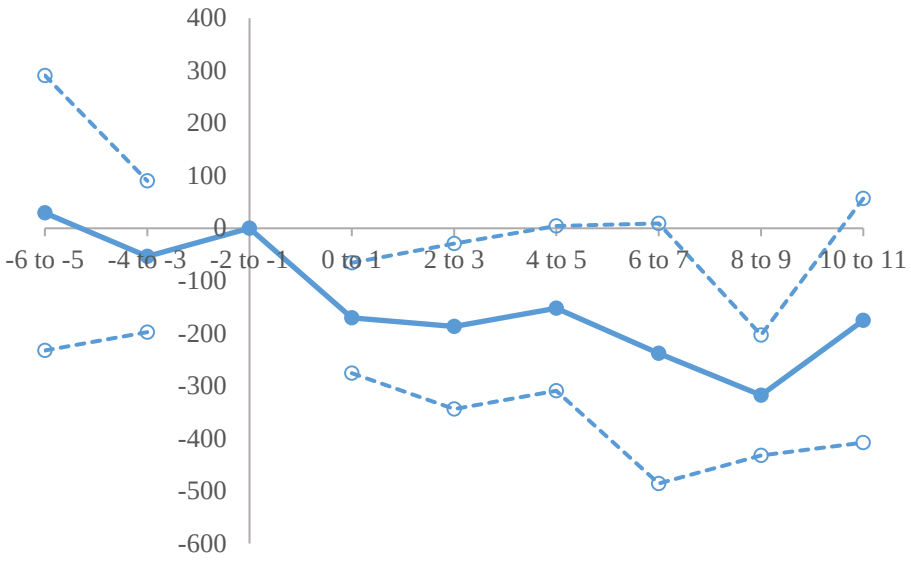
Table 8. Heterogeneous Effect of Merit Aid Spending per Full-Time-Equivalent (FTE) Student on Employment Outcomes of Mothers with a College-Going Child

	(1)	(2)	(3)	(4)	(5)	(6)
	Not Head of Household	**Head of Household**	**Some College**	**High School or Less**	**White**	**Non-white**
A. Dependent Variable: Annual Hours of Work						
Merit per FTE Student	-0.262	-0.0201	-0.280	-0.030	-0.239	-0.0613
	[0.123]**	[0.110]	[0.171]	[0.139]	[0.118]**	[0.0939]
Observations	5067	2823	3631	4009	4060	3830
Pre-treatment Mean	1489	1545	1617	1357	1583	1318
First-stage F-statistic	15.22	21.88	11.03	34.57	14.38	27.49
B. Dependent Variable: Employment Status (percent)						
Merit per FTE Student	-0.00267	-0.00291	-0.00338	-0.00406	-0.0023	-0.00492
	[0.00435]	[0.00453]	[0.00420]	[0.00611]	[0.00352]	[0.00521]
Observations	5067	2823	3631	4009	4060	3830
Pre-treatment Mean	85.95	84.3	92.14	76.93	89.75	74.72
First-stage F-statistic	15.22	21.88	11.03	34.57	14.38	27.49
C. Dependent Variable: Annual Hours of Work if Employed						
Merit per FTE Student	-0.243	-0.00401	-0.273	0.0576	-0.219	0.0571
	[0.140]*	[0.111]	[0.169]	[0.0844]	[0.124]*	[0.0742]
Observations	4172	2293	3244	3030	3478	2987
Pre-treatment Mean	1732	1833	1755	1764	1764	1763
First-stage F-statistic	14.79	16.97	10.8	34.4	14.39	22.02

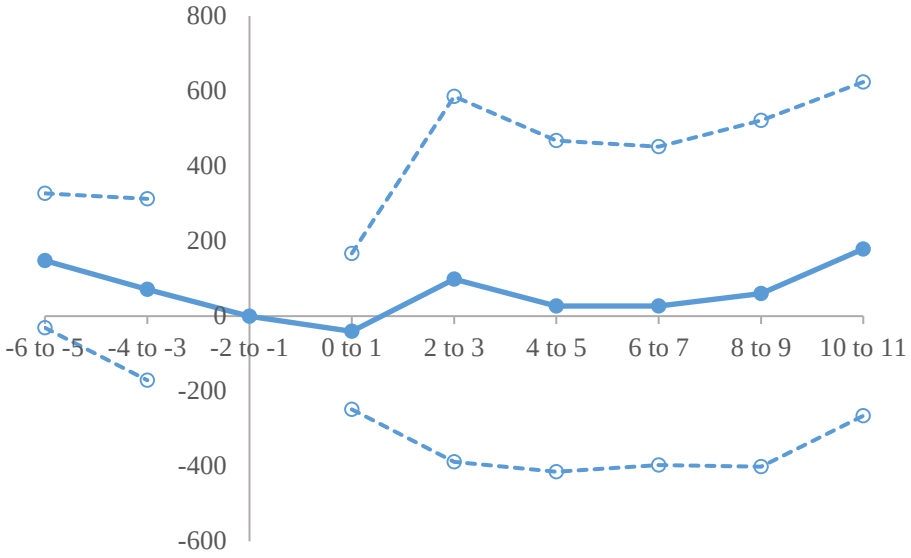
Notes: The estimates present the effect of merit aid spending per full-time equivalent undergraduate student on annual hours of work (panel A), employment status (panel B), and annual hours of work of employed (panel C) mothers of college-going children using an indicator for the period after merit aid introduction in strong states as an instrumental variable. See notes for table 7.

Figure 1. Effect of Merit Aid on Parental Annual Hours of Work

A. Mothers of College-Age Children



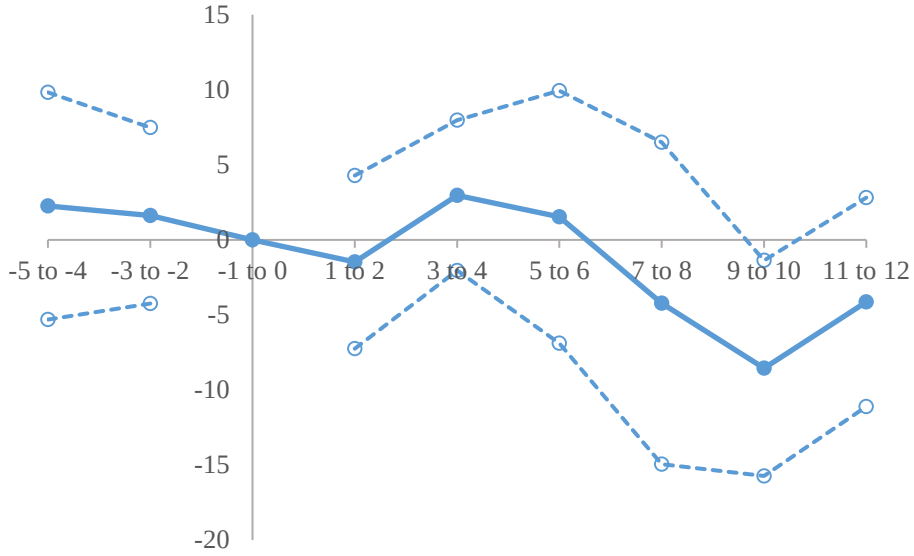
B. Fathers of College-Age Children



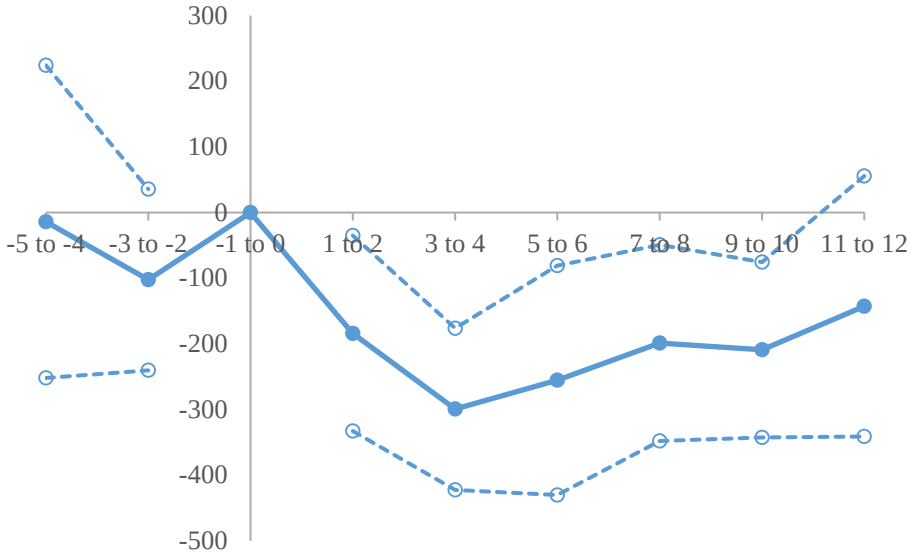
Notes: The graphs present the evolution of annual hours of work before and after merit aid programs for mothers (panel A) and fathers (panel B) with college-age children using equation (1). The *x*-axis represents grouped event years—years since merit aid introduction—that actually include two event years. Event year 0 corresponds to the year a merit aid program is introduced, and we expect that parents will become treated that year, because that is when they find out that their child is eligible to receive merit aid. The estimates are from model (4), which is our baseline specification that includes all co-variates. Regressions are weighted using longitudinal weights. Standard errors are clustered at the state-level and used to construct 95-percent, point-wise confidence intervals (dashed lines). Sources: PSID, NASSGAP, IPEDS, University of Kentucky Poverty Center.

Figure 2. Effect of Merit Aid on Employment Outcomes of Mothers of College-Age Children

A. Employment Status



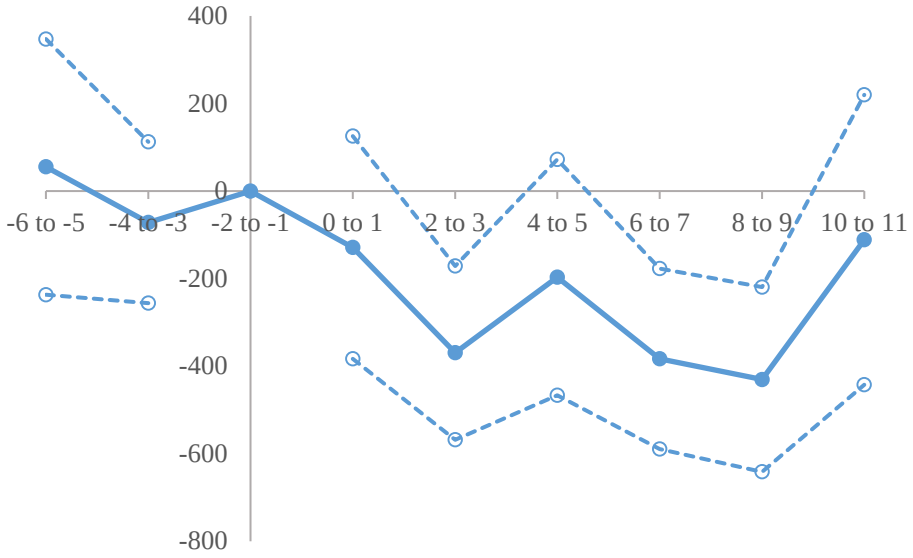
B. Hours of Work if Employed



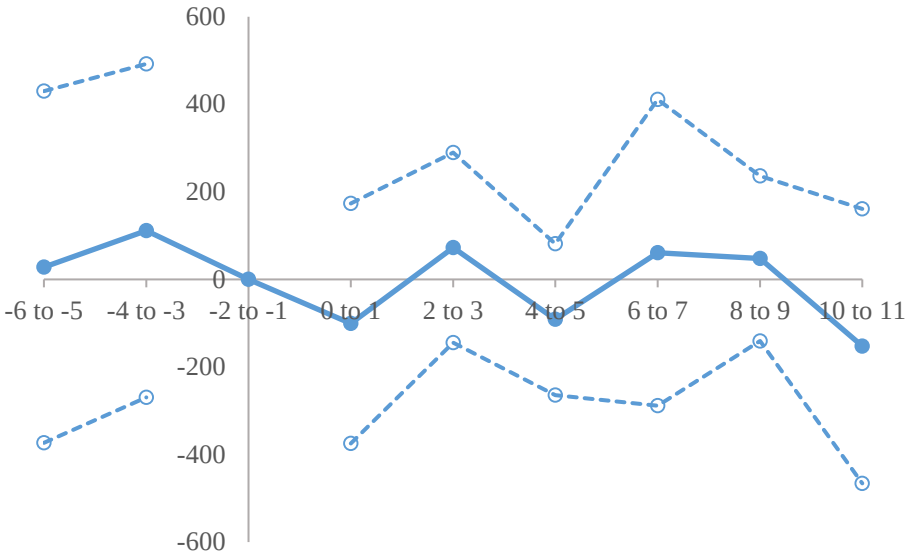
Notes: The graphs present the evolution of employment status (Panel A) and annual hours of work of those employed (Panel B) before and after merit aid programs for women with college-age children using equation (1). See notes and sources for figure 1.

Figure 3. Effect of Merit Aid on Maternal Annual Hours of Work by Children's College-Going Status

A. College-Going Child



B. Not College-Going Child



Notes: The graphs present the evolution of annual hours of work before and after merit aid programs for women with children ages 18 to 22 who have a college-going child (panel A) and do not have a college-going child (panel B) using equation (1). See notes and sources for figure 1.

APPENDIX A. Tables and Figures

Table A1. The Relationship of Year of Merit Aid Start and Employment Outcomes before Program Start

	(1)	(2)
	Annual Hours of Work	**Employment Status**
Year Merit Aid Started	8.09	-0.614
	[21.02]	[0.548]
Observations	1592	1592
Mean Dep Var	1191	71.42

Notes: Estimates are from weighted regressions of annual hours of work (column 1) and employment status (column 2) on the year merit aid programs started in nine states with strong merit aid programs. The sample consists of women in years 1989 to 1992 in the PSID who have children and are ages 35 to 64 years old. Regressions are weighted using longitudinal weights, and standard errors are clustered at the state -level. Source: PSID.

Table A2. Effect of Merit Aid on College Attendance of Children and Composition of Mothers

	(1)	(2)	(3)	(4)	(5)	(6)
	Child in College	**Years of Education**	**White**	**Number of Children**	**Head of Household**	**Age**
A. Women with College-Age Child						
After Merit Aid	-0.0206	0.134	-0.0621	0.00929	-0.00237	0.502
	[0.0347]	[0.163]	[0.0557]	[0.126]	[0.0640]	[0.489]
Observations	12,575	13,408	13,408	13,408	13,408	13,408
Pre-treatment Mean	0.579	13	0.755	2.905	0.330	45.50
B. Women with College-Going Child						
After Merit Aid		-0.00453	-0.0363	-0.0234	-0.0305	0.351
		[0.278]	[0.0435]	[0.177]	[0.0806]	[0.523]
Observations		7,638	7,638	7,638	7,638	7,638
Pre-treatment Mean		13.51	0.781	2.820	0.251	46.03
C. Women without College-Going Child						
After Merit Aid		0.407	-0.0585	-0.0305	0.0424	0.771
		[0.339]	[0.0798]	[0.178]	[0.0826]	[0.902]
Observations		4,937	4,937	4,937	4,937	4,937
Pre-treatment Mean		12.49	0.660	2.985	0.384	44.25

Notes: The coefficients show the effect of merit aid programs on the composition of women with a college-age child (panel A), women with a college-going child (panel B), and women without a college-going child (panel C) over 12 years after the start of merit aid programs. The coefficients come from a difference-in-differences version of equation (1): see notes in table 3. Each column performs a regression using a different dependent variable: a dummy that equals 1 if you have a college-going child in column 1 and years of education in column 2; a dummy that equals 1 if you are white in column 3 and the total number of children in column 4; a dummy that equals 1 if you are a head of household in column 5 and the age in column 6. The estimates are from model (4), which is our baseline specification that includes all co-variates. Sources: PSID, NASSGAP, IPEDS, University of Kentucky Poverty Center.

Table A3. Effect of Merit Aid Programs on Annual Hours of Work of Mothers of College-Age Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Annual Hours of Work of Mothers			
Pre-treatment Mean	1567			
Before Merit Aid Event Years				
-6 to -5	10.01	42.83	42.19	29.23
	[136.5]	[141.1]	[141.8]	[133.5]
-4 to -3	-65.12	-47.71	-49.36	-53.67
	[71.07]	[79.66]	[80.22]	[73.47]
After Merit Aid Event Years				
0 to 1	-136.6	-160.4	-158.7	-170.7
	[37.26]***	[44.26]***	[44.83]***	[53.70]***
2 to 3	-174.7	-164.3	-164.7	-186.7
	[51.35]***	[59.91]***	[59.87]***	[80.29]**
4 to 5	-154.1	-139.3	-139.9	-152.3
	[78.57]*	[75.02]*	[77.68]*	[80.07]*
6 to 7	-203.8	-216.4	-217.3	-238.3
	[116.5]*	[129.8]	[128.8]*	[126.3]*
8 to 9	-278.4	-297.5	-298.6	-317.7
	[80.55]***	[65.62]***	[70.68]***	[58.48]***
10 to 11	-142.7	-171.4	-172.8	-175.6
	[100.3]	[110.2]	[112.5]	[118.6]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	13907	13907	13907	13907

Notes: These coefficients present the evolution of hours of work (for employed and unemployed individuals) for mothers with a college-age child before and after the introduction of merit aid using equation (1). Event year is year of observation minus the year of merit aid program start, so event year 0 corresponds to the year of merit aid start. The omitted event years are -1 and -2, and states without merit aid programs are in the omitted group. Column (1) includes state and year fixed effects; column (2) adds individual-level controls: race, education fixed effects, age fixed effects, marital status dummies, number of children, and household headship; column (3) adds state-level educational controls: need-based aid spending per full-time-equivalent (FTE) student and state average tuition and fees for FTE undergraduates separately in 4-year and 2-year degree institutions; and column (4) includes state-level macroeconomic controls: the unemployment rate, log state revenue, state minimum wage, whether the governor is a democrat, the poverty rate, number of AFDC/TANF recipients, and number of food stamp/SNAP recipients. Regressions are weighted using longitudinal weights. Standard errors are clustered at the state level and presented in brackets under the coefficients. Statistically significant at ***0.01, **0.05, *0.10. Sources: PSID, University of Kentucky Poverty Center, and IPEDS.

Table A4. Effect of Merit Aid Programs on Annual Hours of Work of Fathers of College-Age Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Annual Hours of Work of Fathers			
Pre-treatment Mean	1841			
	Before Merit Aid Event Years			
-6 to -5	179.4	162.6	167.3	147.9
	[89.48]*	[94.15]*	[88.01]*	[91.29]
-4 to -3	46.02	67.43	75.22	71.11
	[113.8]	[127.7]	[125.7]	[123.3]
	After Merit Aid Event Years			
0 to 1	-42.29	-78.8	-53.99	-40.58
	[107.0]	[111.4]	[109.8]	[106.0]
2 to 3	51.68	31.3	71.94	98.36
	[251.8]	[245.4]	[240.6]	[248.4]
4 to 5	1.308	-31.24	15.75	26.52
	[214.2]	[212.0]	[209.7]	[225.1]
6 to 7	17.89	-67.47	-1.732	27.21
	[234.0]	[222.3]	[204.6]	[216.6]
8 to 9	-0.653	-57.26	28.1	60.24
	[240.9]	[242.6]	[223.4]	[235.5]
10 to 11	137.1	70.82	148.5	179
	[222.2]	[228.0]	[216.7]	[227.0]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	9832	9832	9832	9832

Notes: See notes for table A3.

Table A5. Effect of Merit Aid Programs on Employment Status of Mothers of College-Age Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Employment of Mothers			
Pre-treatment Mean	81.49			
Before Merit Aid Event Years				
-6 to -5	1.019	2.444	2.369	2.258
	[4.760]	[4.318]	[4.274]	[3.858]
-4 to -3	0.913	1.652	1.642	1.627
	[3.752]	[3.201]	[3.190]	[2.990]
After Merit Aid Event Years				
0 to 1	-0.531	-0.76	-0.72	-1.478
	[3.204]	[3.043]	[3.030]	[2.945]
2 to 3	3.014	3.645	3.818	2.967
	[2.686]	[2.356]	[2.335]	[2.554]
4 to 5	0.709	1.03	1.273	1.533
	[5.277]	[4.442]	[4.505]	[4.290]
6 to 7	-4.475	-4.477	-4.077	-4.22
	[5.575]	[5.650]	[5.543]	[5.476]
8 to 9	-8.457	-8.472	-8.071	-8.549
	[4.435]*	[3.809]**	[3.803]**	[3.662]**
10 to 11	-5.208	-5.328	-4.894	-4.145
	[2.987]*	[3.450]	[3.518]	[3.548]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	13907	13907	13907	13907

Notes: See notes for table A3.

Table A6. Effect of Merit Aid Programs on Annual Hours of Work of Employed Mothers of College-Age Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Hours of Mothers if Employed			
Pre-treatment Mean	1923			
Before Merit Aid Event Years				
-6 to -5	-18.13	-0.69	0.663	-13.96
	[121.0]	[129.4]	[130.5]	[121.5]
-4 to -3	-108.3	-98.7	-99.69	-102.3
	[71.71]	[79.18]	[79.04]	[70.44]
After Merit Aid Event Years				
0 to 1	-154.8	-185.9	-184.9	-184
	[79.43]*	[77.13]**	[76.81]**	[75.88]**
2 to 3	-276.5	-285.5	-290	-299.2
	[39.35]***	[47.20]***	[48.56]***	[62.77]***
4 to 5	-215	-223.3	-229.4	-255.5
	[70.35]***	[82.16]***	[85.58]**	[89.10]***
6 to 7	-152.1	-161.2	-170.2	-198.7
	[54.91]***	[67.28]**	[67.34]**	[76.24]**
8 to 9	-162.4	-188.6	-198	-209.1
	[65.96]**	[61.55]***	[62.71]***	[68.11]***
10 to 11	-68.81	-114.7	-125.1	-142.6
	[90.52]	[87.73]	[87.52]	[101.2]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	10842	10842	10842	10842

Notes: See notes for table A3.

Table A7. Effect of Merit Aid Programs on Annual Hours of Work of Mothers of College-Going Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Annual Hours of Work of Mothers			
Pre-treatment Mean	1659			
Before Merit Aid Event Years				
-6 to -5	70.98	67.96	68.79	55.26
	[160.9]	[150.5]	[153.0]	[149.0]
-4 to -3	-104.6	-60.5	-62.49	-71.85
	[82.37]	[98.22]	[97.23]	[94.13]
After Merit Aid Event Years				
0 to 1	-98.03	-99.88	-99.81	-128.8
	[165.1]	[136.0]	[134.2]	[129.8]
2 to 3	-325.8	-324.7	-329.3	-369.7
	[105.9]***	[85.23]***	[89.53]***	[101.1]***
4 to 5	-153.2	-164.5	-169.6	-197.1
	[216.6]	[159.6]	[162.0]	[137.3]
6 to 7	-332.6	-331.8	-341.8	-383.3
	[151.1]**	[121.5]***	[123.8]***	[105.1]***
8 to 9	-368.6	-387.4	-397.1	-430.4
	[172.0]**	[122.1]***	[127.9]***	[107.7]***
10 to 11	-72.87	-89.1	-97.59	-111.4
	[151.9]	[152.8]	[155.8]	[169.0]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	7890	7890	7890	7890

Notes: See notes for table A3.

Table A8. Effect of Merit Aid Programs on Annual Hours of Work of Mothers without College-Going Children

	(1)	(2)	(3)	(4)
	Dependent Variable: Annual Hours of Work of Mothers			
Pre-treatment Mean	1363			
Before Merit Aid Event Years				
-6 to -5	-84.63	42.8	38.66	28.35
	[186.7]	[206.9]	[207.0]	[204.8]
-4 to -3	121.5	116.4	113.6	111.4
	[184.7]	[192.9]	[194.3]	[194.3]
After Merit Aid Event Years				
0 to 1	-65.03	-111.4	-109.4	-100.4
	[131.0]	[131.4]	[132.0]	[139.9]
2 to 3	51.76	57.48	65.44	72.64
	[100.1]	[105.9]	[106.2]	[110.7]
4 to 5	-101.5	-105.7	-95.02	-91.43
	[90.92]	[83.70]	[78.54]	[88.18]
6 to 7	102	33.56	49.53	61.22
	[166.7]	[180.0]	[174.8]	[178.5]
8 to 9	26.74	24.45	41.61	47.68
	[83.03]	[101.0]	[101.9]	[96.07]
10 to 11	-147.8	-182.3	-166.5	-152.3
	[158.2]	[151.5]	[152.3]	[160.0]
Covariates	FE: State, Year	FE: State, Year; Xind	FE: State, Year; Xind; Xeduc	FE: State, Year; Xind; Xeduc; Xmacro
Observations	5162	5162	5162	5162

Notes: See notes for table A3.

Table A9. Effect of Merit Aid Programs on Merit Aid Spending per Full-Time-Equivalent Undergraduate Student

	(1)	(2)	(3)	(4)
A. Mothers of College-Age Children				
After Merit Aid	1173	1170	1127	1094
	[305.8]***	[301.8]***	[260.2]***	[255.2]***
Observations	13907	13907	13907	13907
B. Mothers of College-Going Children				
After Merit Aid	1180	1186	1156	1125
	[328.2]***	[321.4]***	[286.1]***	[280.7]***
Observations	7890	7890	7890	7890

Notes: These coefficients correspond to results from the first-stage equation (2) of the instrumental variable that equals 1 in years after merit aid programs started in states with strong programs on merit aid spending per full-time-equivalent undergraduate student and zero in strong states before merit aid programs and in states without merit aid programs. See notes for table A3 for descriptions of models in columns (1) to (4) and sources.

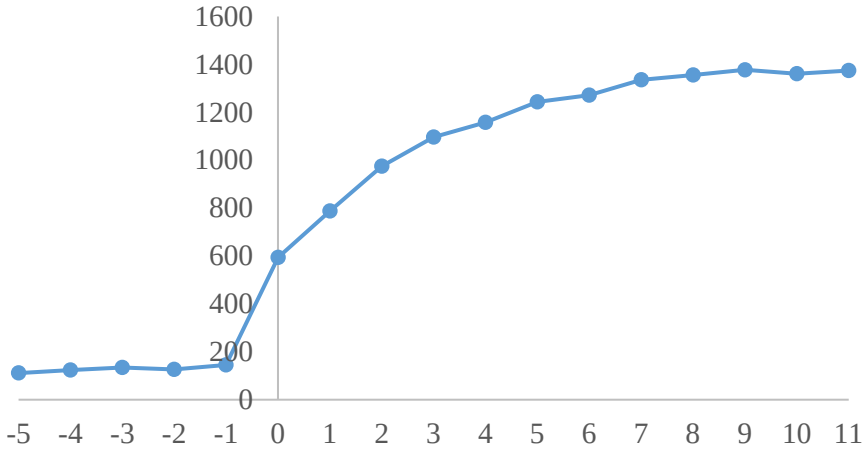
Table A10. Effect of Merit Aid Programs on Annual Hours of Work among Women with No College-Going Children

	(1)	(2)	(3)	(4)
A. Difference in Differences Specification				
After Merit Aid	-29.40	-89.06	-90.94	-79.47
	[128.5]	[135.9]	[141.3]	[148.5]
Pre-treatment Mean	1363	1363	1363	1363
B. Instrumental Variables Specification				
Merit spending per FTE student	0.0176	-0.0301	-0.0264	-0.0107
	[0.0656]	[0.0670]	[0.0781]	[0.0831]
Observations	5,261	5,261	5,261	5,261

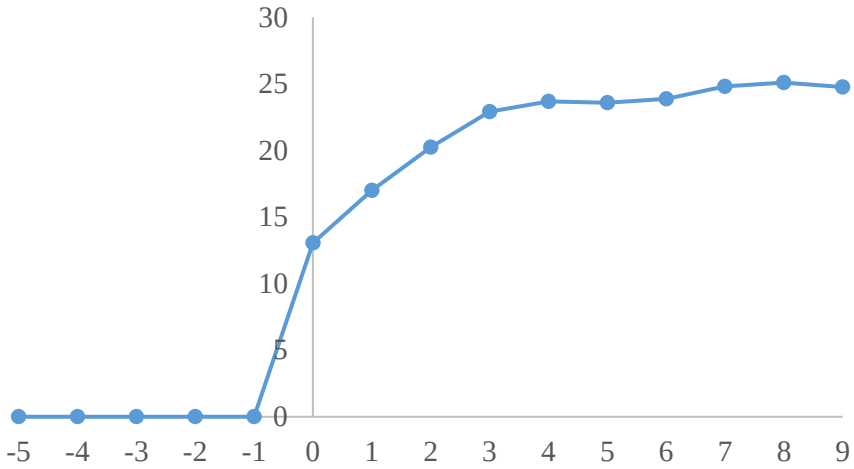
Notes: The coefficients show the effect of merit aid programs (panel A) and spending on merit aid programs (panel B) on annual hours of work of mothers with not college-going children over 12 years after the start of merit aid programs. See notes and sources in table 3 for panel A. See notes and sources in table 5 for panel B.

Figure A1. Merit Aid Spending and Eligibility before and after Program Start

A. Merit Aid Spending per Full-Time-Equivalent Student

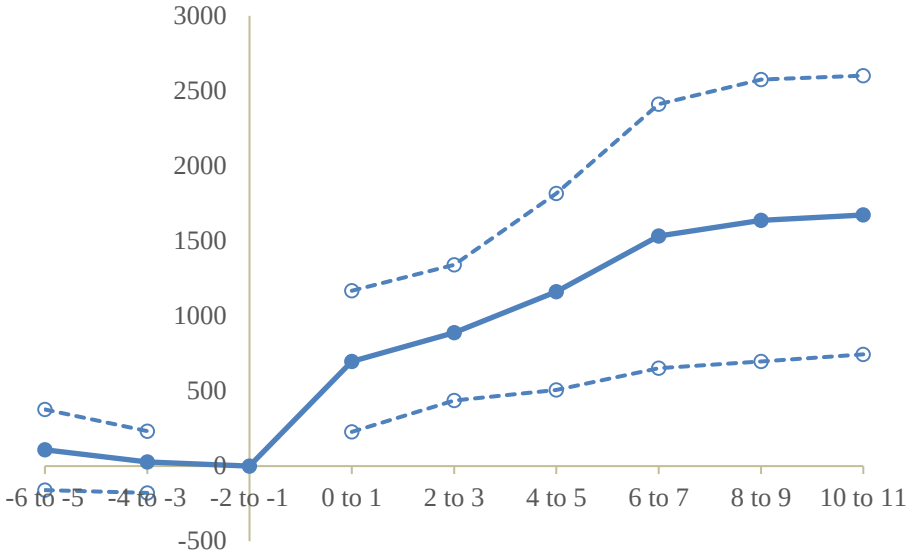


B. Percentage of Students Receiving Merit Aid



Notes: The graphs represent the evolution of merit aid spending (in 2015 dollars) per full-time-equivalent undergraduate student (panel A) and the share of students receiving merit aid (panel B), where the event year is on the *x*-axis. Event year is the year of observation minus the year of merit aid program start, so event year 0 corresponds to the year of merit aid start. Sources: Panel A: NASSGAP Annual Reports, IPEDS; Panel B: Frisvold and Pitts (2018).

Figure A2. Effect of Merit Aid on Spending per Full-Time-Equivalent Student in PSID Sample of Mothers with a College-Age Child



Notes: The graph presents the evolution of merit aid spending per full-time undergraduate student (in 2015 dollars) before and after merit aid programs for states of residence of mothers of college- age sample in our main PSID sample using equation (1). The analysis is at the individual level, where mothers living in the same state and year receive the same value of merit aid spending. See notes and sources for figure 1.

APPENDIX B

Construction of College Attendance in the PSID

To create the college attendance measure we use several PSID variables, which are summarized in the table below.

Variable name	Question	Years	Options
Employment Status	Are you working now?	1988 to 2015	work, laid off, looking for work, retired, disabled, keeping house, student
Whether a Student	Are you enrolled as a full-time or part-time student?	1988 to 2009	full-time, part-time, not enrolled
Completed Education	What's the highest year of school you completed?	1988 to 2015	1 to 17
Last Year in School	What year did you last attend school?	1988 to 2013	calendar years
Attend College (Transition into Adulthood sample)	Are you currently attending college?	2005 to 2015	yes, no

First, we define someone as a high school graduate if they obtain at least 12 years of education. Second, we define a measure for whether an individual is enrolled in college in the current PSID wave.

An individual is classified as in college in the current year if:

(1) Chooses "student" as an answer to the "employment status" question and is a high school graduate.
(2) Chooses "full-time" or "part-time" student as an answer to "whether a student" question, is a high school graduate, and chooses the current year as an answer to "last year in school."
(3) Increases his completed education years in the next wave relative to the current wave of the PSID, according to the "completed education" variable, and is a high school graduate.
(4) Lists himself as attending college in the Transition into Adulthood Supplement (TAS): chooses "yes" as an answer to the "attend college" question.

An individual is classified as not in college in the current year if:

(1) Is not a high school graduate.

(2) Does not choose “student” as an answer to the “employment status” question and is a high school graduate.
(3) Chooses a year before the current year as an answer to the “last year in school” question and is a high school graduate.
(4) Lists himself as not attending college in the TAS: chooses “no” as an answer to the “attend college” question.