# Time to Grow Up? Adult Children as Determinants of Parental Labor Supply

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ABSTRACT

As children transition to adulthood, do they continue being a major determinant of parental labor supply? To answer this question, we examine the effects of college costs on the labor supply of mothers and fathers by exploiting the roll-out of nine generous state merit aid programs from 1993 to 2004, which made college more affordable. Mothers of college-age children decrease their annual hours of work after the introduction of these state-wide programs, while fathers do not adjust their labor supply. Mothers of college-going children are entirely responsible for the decline in hours of work, where mothers of children who do not go to college experienced no change in hours of work. The decline in labor supply is mainly due to adjustments among married, more educated, and white mothers.

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Children are widely acknowledged as one of the most important determinants of female labor supply. The academic literature has focused on the effects of the birth of a child and finds that women – but not men – experience substantial and persistent declines in employment after childbirth.[1] These declines may be influenced by the time-requirements of young children, availability of family friendly policies, child-care provision, and gender norms and culture. However, little is known about the effect of a child's transition to adulthood on parental employment. Yet, parents continue to transfer a great deal to their adult children: college expenses, co-residence, rent, expenses related to major life events such as weddings, the birth of a child or buying a house, and transfers that cushion against negative financial shocks are increasingly important parental transfers.[2] Once they grow up, do children *stop* being a critical determinant of labor supply for mothers, and/or do they *become* a critical determinant for fathers? The labor supply decisions of parents with adult children are fundamentally different from those with young children, because parents are at a more advanced stage in their career, closer to retirement, and adult children generally require less time-intensive and mother-specific care.

In this paper, we examine how parental labor supply varies as children transition into adulthood and, eventually, out of the household. Causal inference within this framework is challenging due to difficulties in finding exogenous changes in the costs of adult children. This study takes advantage of the staggered state roll-out of nine generous merit aid programs from 1993 to 2004 which made college more affordable to a substantial number of families. Since the early 1990s, many states have established state-sponsored merit aid programs for young residents

[1] See: Kleven, Landais, and Søgaard 2019, and Kuziemko, Pan, Shen, and Washington 2018.
[2] See: Andersen, Johannesen, and Sheridan 2020, Kaplan 2012, and McGarry 2016. Published tuition and fees at public four-year universities rose by about 200 percent from 1989 to 2019 (College Board 2018), and 36 percent of young adults ages 18 to 31 lived with their parents in 2012 (Pew Research Center 2013).

who have maintained a modest grade point average in high school and enrolled in a post-secondary institution in their state of residence.[3] Theoretically, the introduction of merit aid represents a positive shock to the disposable income of families, because parental income is the primary source of funding for college expenses.[4] Thus, merit aid may substantially decrease parental labor supply for several reasons. First, families expect to receive this transfer for many years: in every year that each child attends college and is eligible for the program. Second, merit aid may lead to lower tuition, because students may shift enrollment from higher cost out-of-state colleges towards lower-cost in-state colleges as a response to the aid (Zhang and Ness 2010). Third, parents may decrease their labor supply by more than they prefer, because of adjustment costs in hours of work (Chetty, Friedman, Olsen, and Pistaferri 2011).

To the best of our knowledge, this is the first study to causally link costs of adult children and parental labor supply by focusing on the specific example of reduced college costs. We exploit the variation in the years that merit aid programs were established, using a two way fixed effects difference-in-differences framework (TWFE DiD) to causally estimate both short-run and dynamic 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 also exploit variation in merit aid spending across states to estimate the effect of merit aid per dollar of spending on paternal and maternal labor supply; we construct annual merit aid spending per full-time-equivalent undergraduate enrolled student, in each state, using information from the National Association of State Student Grant and Aid Programs (NASSGAP)

[3] For example, the Georgia HOPE scholarship covers 84 percent of tuition for students at university-system institutions, with 36 percent of these students receiving the award in 2015 (Suggs 2016).
[4] 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).

and the Integrated Postsecondary Education Data System (IPEDS). We focus on parents with a potentially eligible child by performing the analysis separately 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. One concern of using the sample of parents with college-going children is the potential effect of merit aid on college enrollment which may change the composition of this sample. While results from previous literature are mixed regarding this issue, we find no evidence that merit aid affected college-going or the composition of mothers of college-going children in our sample.[5]

The introduction of merit aid programs resulted in a decline in hours of work among mothers, but no adjustment among fathers. The decline in hours of work among mothers was mostly due to adjustments at the intensive margin, while we find mixed evidence of adjustments along the extensive margin. Moreover, the decline in hours of work was entirely due to adjustments among women with college-going children; we find no adjustments among women without college-going children (a placebo group). A 10 percent increase in spending on merit aid programs per undergraduate student is associated with a 1.3 percent decline in hours of work among mothers of college-going children. These reductions in labor supply are consistent with a limited correlational literature, suggesting a link between college expenses and parental economic outcomes. For instance, Handwerker (2011) shows that parents are more likely to work while their children attend college, while Faber and Rich (2018) find that increasing rates of college attendance predict increases in foreclosure rates. Finally, several papers document that financial aid based on assets is connected with lower savings rates (Dick and Edlin 1997, Edlin 1993,

[5] Dynarski (2004) and Cornwell, Mustard, and Sridhar (2006) find modest positive effects on college enrollment; Goodman (2008) finds no effects. Dynarski (2008) and Scott-Clayton (2011) find positive effects on college completion; Fitzpatrick and Jones (2016) and Sjoquist and Winters (2015b) find no effects.

Feldstein 1995, and Long 2003).[6]

We provide many robustness checks for the validity of our two-way fixed effects difference-in-differences (TWFE DiD) model. First, we provide empirical and anecdotal evidence that the timing of merit aid introduction is conditionally random. Second, our results are robust to alternative estimators mitigating concerns over bias in TWFE DiD models due to differential treatment effects across time and states.[7] Third, we provide evidence of parallel pre-trends using the test developed in Borusyak et al. (2021). Finally, we find no decline in hours of work among mothers of college-going children whose youngest children are older than college-age.

Do effects of merit aid programs differ across mothers? The decline in labor supply is almost entirely due to advantaged mothers, who are married, more educated, and white. Advantaged mothers likely adjusted labor supply the most because their children are disproportionately eligible for merit aid (Dynarski 2004, and Farrell 2004), and are not eligible for other forms of financial aid.[8] In addition, most of the merit aid grant that children of disadvantaged mothers are eligible for is likely displaced by other types of financial aid resulting in much smaller merit grants.[9] Our findings are consistent with the literature showing that married mothers are more responsive to transfers than single mothers (Eissa and Hoynes 2004, and Powell 2020). Finally, the decline in labor supply is larger for mothers with multiple children in college, consistent with these families receiving merit aid for multiple children.

Taking advantage of the longitudinal structure of the PSID, we investigate the dynamic

[6] Ding, Lugauer and Bollinger (2019) link increases in both college-going and savings rates in China.
[7] We implement estimators from: Borusyak, Jaravel and Spiess 2021, Callaway and Sant'Anna 2021, Cengiz, Dube, Lindner, and Zipperer 2019, de Chaisemartin and d'Haultfœuille 2020, and Goodman-Bacon 2021.
[8] We also considered using information on school grades from the PSID's Child Development (CD) to identify high achieving students more likely to be eligible for state merit aid. However, the oldest cohort in the CD supplement turned age 18 in 2003, when eight of the nine strong merit aid states had already started their programs.
[9] Most disadvantaged students receive enough aid from sources like Pell grants and state need-based programs to cover their tuition and fees (College Board 2018). Most merit aid programs are "last dollar" – other financial aid displaces merit aid, which in most cases is limited to tuition and fees.

effects of college costs on labor supply. For this purpose, we estimate the effect of merit aid on mothers 1 to 2 years before their *first* child enrolls in college (anticipation effect) and 1 to 2 years *after* the last child leaves college (persistent effect). We find suggestive evidence that mothers decrease their labor supply before their first child attends college, and that this decrease persists after the last child leaves college. However, these declines are substantially smaller than the ones we estimate while children are in college and are not statistically significant. Thus, while effects of merit aid are mainly concentrated in the years when children are in college, we find suggestive evidence of smaller anticipation and persistent effects of merit aid.

To conclude, this study demonstrates that child-related costs continue to be a determinant of maternal labor supply, even when children grow up. Thus, this study identifies a previously unexplored determinant of maternal labor supply – costs of adult children. However, adult children do not become a determinant of paternal labor supply, even though they no longer require mother-specific care. Given the sizable magnitudes of parental transfers to adult children (Haider and McGarry 2018), it is important to understand the potential effects of such transfers on parents.[10]

In particular, this study provides novel insights on potential effects of policies that make college more affordable to families. In response to merit aid programs, the group that reduced their labor supply primarily consisted of advantaged mothers. As tuition fees have continued to grow, and the college affordability debate has been gaining importance in political and policy discussions (Baum and Turner 2019, Harris 2019, and Chingos and Blagg 2019), it is important to evaluate the effect of college costs on parental economic outcomes.[11]

[10] Aggregate transfers to adult children are larger than college expenses (Haider and McGarry 2018).
[11] College costs are a substantial burden on 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).

## I. Background on Merit Aid Programs

### *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 grant amounts to young residents who have maintained a modest grade point average in high school. In all states, students may use merit aid grants to cover tuition and fees, while in some states merit aid also covers additional expenses, such as room and board, books, or lab equipment.[12] 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. Virtually all state merit aid programs also require students to maintain a certain GPA in college to renew the award for subsequent years, although the required GPA may differ across states.[13] There is generally no means test for eligibility, and award amounts do not differ by family income.[14] Most merit aid programs are "last-dollar" programs, meaning that other forms of financial aid, such as Pell grants, displace the merit aid grant, and students can only receive the difference between the merit aid grant they qualify for and the grant from other financial aid. However, a few programs, such as the Louisiana TOPS Scholarship, are "first-dollar" programs, meaning that other forms of financial aid do not displace the state merit aid, for students eligible for multiple types of aid. In all states, students may use merit aid grants to cover tuition and fees, while in some states merit aid also covers additional expenses, such as room and board, books, or lab equipment.

Among many goals, these programs aim to improve the quality of education in the state by

[12] For example, the Georgia Hope grants can only be applied toward undergraduate tuition, while the Florida Bright Scholarship can also be used to cover additional expenses.
[13] The minimum GPA for renewal is typically 2.75-3.0 but is as low as 2.3 for the first year in Louisiana and 2.5 in subsequent years (Sjoquist and Winters 2015a).
[14] 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.

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, these programs may offer low-income, high-achieving students who cannot afford college the chance to enroll in college (Barlament 2019).

Following the literature on merit aid programs, Table 1 classifies nine programs as "strong" due to their larger participation rates and average awards (Sjoquist and Winters 2015).[15] Strong merit aid states are 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 these programs. Spending on merit aid programs grew in their early years, but it tapered off as they became more established (Appendix figure A1). 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 51 percent of 18-22 years old undergraduates received merit aid in 2011. Finally, Louisiana offers the most generous package, with the maximum aid covering more than 110 percent of the average tuition and fees of a public four-year institution in the state.

### *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, and Cornwell et al. 2006) or no effects (Goodman 2008) on college enrollment and positive effects (Dynarski 2008, and Scott-Clayton 2011) or no effects on college completion (Fitzpatrick and Jones 2016, and Sjoquist and Winters 2015b). In addition, some papers find evidence that

[15] Note that this paper corrects the start date to be 2004 in Tennessee.

merit aid programs improve college readiness (Pallais 2009, and Castleman 2014).

Minority and low-income students are disproportionally less likely to be eligible for merit aid (Dynarski 2004, Farrell 2004, Heller and Rasmussen 2002, and Ness and Noland, 2007). As a result, merit aid programs subsidize many students who would have gone to college anyway (Carruthers and Özek 2016, Cornwell et al. 2006, and Fitzpatrick and Jones, 2016). Finally, these programs lead to an increase in the consumption of goods such as expensive cars and alcohol (Cornwell and Mustard 2007, and Cowan and White 2015) and a reduction of student debt (Chapman 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. 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. Conceptual Framework

The introduction of merit aid is an unexpected positive shock to the disposable income of families of college going children, which has implications for consumption, family net worth, and labor supply of families. First, positive income shocks lead to an increase in the consumption of normal goods. Consistent with this theory, the introduction of merit aid is associated with an increase in automobile purchases (Cornwell and Mustard 2007) and alcohol consumption in college (Cowan and White 2015). Second, income shocks increase family net worth, with parents and children using the extra resources to increase savings and decrease debt. In fact, qualifying for

merit aid programs lowers the student loan burden of college graduates by $5,800-$7,200 (Chapman 2015). Finally, because leisure is a normal good, income shocks resulting from merit aid may also lower parental labor supply.

Merit aid may have a substantial effect on the family's finances and parental employment for several reasons. First, families may have multiple children receiving this annual grant (mothers of college going children have on average 2.8 children in our sample) and could benefit from it for several years while their children attend college.[16] Second, given the structure of the program, students tend to shift their enrollment from higher-cost out-of-state state colleges towards lower-cost in-state colleges (Cornwell et al. 2006). In fact, the introduction of merit aid has decreased the number of students from merit aid states who attend out-of-state universities by nearly 9 percent (Zhang and Ness 2010). As a result, families in merit aid states may save much more than the merit aid transfer on college costs, when enrolling their children in-state. Third, responses to income shocks may differ if individuals face fixed adjustment costs of working hours (Chetty et al. 2011). Given that merit aid is a substantial income shock, parents may have to decrease their labor supply by more than they prefer, because they cannot manipulate their hours of work perfectly.

What are the dynamic effects of merit aid programs on parental labor supply? A canonical dynamic life-cycle labor supply model predicts that families would smooth consumption and labor supply decisions overtime in response to expected future positive income transfers, as long as future consumption is discounted, and families have no barriers to borrow and save. Thus, parental labor supply may adjust in years before the children enroll in college; with the dynamic response depending on parental expectations about the benefits of merit aid, their intertemporal preference

[16] Section VI.B shows that merit aid has stronger effects for mothers with multiple children in college.

and the costs to borrow.[17] The canonical model also predicts that this adjustment may persist even after all children leave college. In fact, Cesarini et al. (2017) show that the income shock from winning the lottery has persistent effects on labor supply that are roughly constant over time and last over 10 years.[18]

## III. Data

This research requires us to match parents to children 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 (ages 18 to 22) 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.[19] 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.

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

[17] While little is known about maternal anticipation effects of future costs of children, the spousal labor supply increases as a response to learning about a partner's future job loss (Hendren 2017).
[18] Section VII tests if mothers adjust their labor supply before and after their children enroll in college.
[19] We have data for 1988 to 1997 in every year, and every other year for 1999 to 2015.

age 19 to 23 in the PSID survey year.[20] We construct the employment status variable using annual hours of work in the past calendar year.[21] 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 combining several variables, following an approach similar to Lovenheim (2011) and based on correspondence with experts at the PSID. 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.

Table 2 shows the summary statistics of our sample of mothers and fathers with college-age children (panel A) and mothers of college-going and not college-going children (panel B). 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 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 (panel B) are more likely to be employed and work more hours; be white, older, more educated, and married; and have fewer children than mothers of non-college goers.

Our analysis focuses on nine generous merit aid programs (we call these "strong") where both a large share of students are eligible and a large share of tuition and fees is covered by aid

[20] 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.
[21] A person is employed if she works at least 52 hours a year.

(Sjoquist and Winters 2015).[22] In table 1 we use data from several data sources to construct three state-level variables to describe the intensity of merit aid programs. First, to construct the annual merit grant aid spending per full-time equivalent (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). Second, to construct the share of 18 to 22 year old undergraduate students receiving merit aid, we use the National Postsecondary Student Aid Study (NPSAS). Finally, to construct maximum merit aid as a percentage of tuition and fees in public four-year institutions we use data compiled by Frisvold and Pitts (2018).

## IV. Effect of Merit Aid on Parental Labor Supply

### *A. Two-Way Fixed Effects Difference-in-Differences (TWFE DiD) 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 a TWFE DiD framework when treatment timing varies in the following specification,

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

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*; $\gamma_t$ are year fixed effects; $\delta_s$ 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 paired event years, *EY*, to keep our sample of states balanced within each paired event year.[23] Thus, $1(EY = \tau)$ is a dummy that represents paired event years, which we

[22] We exclude Arkansas that introduced a strong merit aid program in 2010, from our sample because we would need to restrict our analysis to a much shorter post-merit-aid period.
[23] Not all states are in the PSID 2 years after merit aid started, but all states are 2 to 3 years after.

define as paired years relative to the start of merit aid within a state.[24] The paired 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 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. All years are included in the regression. We 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. Following the literature (Bailey, Malkova and McLaren 2019), while these unbalanced event years are included in the regression, we only present results for a balanced set of paired event years.

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. We omit EY=0 in the regression equation. We include all states in our analysis: for states that implemented merit aid programs $EY$ = 0 represents 1 to 2 years before merit aid started, while for states that did not implement these programs $EY = 0$ represents all years.

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 undergraduate student separately in public four-year and two-year degree institutions, also from IPEDS. These covariates control for other state-level higher education policy changes that might happen during the

[24] An event year is the year of observation minus the year of merit aid program start.

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 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.[25]

Our coefficient of interest is $\pi_\tau$, which measures the effect of merit aid on parental outcomes $\tau$ paired 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 paired event years -2 to 6 (or event years -6 to 11).

After presenting results in an event-study framework, we also summarize our results in a difference-in-differences specification. The paired event year dummies, $1(EY = \tau)$, are replaced with dummies for paired event years -3 and below ($1(EY \leq -3)$), 1 to 6 ($1(1 \leq EY \leq 6)$), and 7 and above ($1(EY \geq 7)$).[26] The coefficient on the dummy for paired 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 Empirical Framework*

We provide both institutional and empirical evidence supporting the identifying

[25] We include all states for which we have data in the PSID, resulting in 49 clusters.
[26] Coefficients for dummies of paired event years -3 and below, and 7 and above, are based on an unbalanced set of states, so we do not display those coefficients in tables.

assumptions in the empirical framework. The critical assumption entails that the year of merit aid start is conditionally random (Athey and Imbens 2021). First, institutional details support this assumption. Most of 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 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 also supports that the timing of merit aid programs was conditionally random. First, we show that there is no relationship between employment outcomes before merit aid 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. Second, an approach to evaluating robustness to omitted variable bias is to observe coefficient movements after inclusion of controls (Altonji, Conley, Elder, and Taber 2019). We find that the inclusion of educational, economic, and political controls does not affect our main results. Third, 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 started. Fourth, we conduct a placebo test on mothers of college-going children whose youngest child is older than college-age and do not find evidence that they decreased their labor supply after merit aid started.

Finally, we show evidence of parallel pre-trends of parental employment outcomes before merit aid start: pre-trend coefficients ($\theta$) are on a flat trend and not statistically different from zero

in our event study figures, and a test developed by Borusyak et al (2021) provides further evidence of parallel pre-trends. A traditional test of parallel trends involves visually or statistically testing whether the coefficients on leads ($\theta$) are equal to zero in equation (1). However, this may be problematic, because these pre-trend estimates are correlated with the estimates of treatment effects obtained from the same specification (Roth 2018). To mitigate these pre-trend testing concerns, we also perform a test developed in Borusyak et al. (2021) that separates testing of parallel trends from estimation.

### *C. Results: Hours of Work of Parents of College-age Children*

Figure 1 displays event-study estimates of the effect of merit aid on hours of work of mothers and fathers of college-age children. This figure includes individuals who are employed and unemployed, where annual hours of work equal zero for those who did not work. 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 paired years before merit aid started, and estimates to the right of the vertical axis present paired years after merit aid started, where each paired event year actually includes two years.[27] Thus, the graph extends to 6 years before and 11 years after merit aid started. Dashed lines plot 95-percent, point-wise confidence intervals. 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.

We show evidence in support of parallel pre-trends. First, the coefficients ($\theta$) on negative paired event years are small and statistically insignificant. Second, we use a test from Borusyak et al. (2021) yielding a p-value is 0.59, which means we cannot reject the null hypothesis that the pre-trend coefficients are jointly zero.

[27] Paired 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).

Panel A of figure 1 shows that mothers of college-aged children worked significantly fewer hours after merit aid started. The effect of merit aid appears in a notable drop in coefficients, evidenced by negative and statistically significant coefficients on positive paired event years. Table 3 (panel A) shows that hours of work dropped by 194 hours per year, representing a 12.4 percent decline relative to the pre-treatment mean. 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. Moreover, tables A4, A7 to A9, and A11 show the robustness across specifications for our entire set of dependent variables.

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.[28] This result is consistent with the literature finding that historically female labor supply elasticities are larger than male elasticities (Bargain and Peichl 2016). Yet, while the sample of lottery winners may be different from that of parents of college-age students, the null effects for fathers is surprising given empirical evidence showing that men and women react equally to income shocks (Cesarini et al. 2017). Given the null effect on fathers, the rest of the paper focuses on mothers.

### *D. Robustness of TWFE DiD: Alternative Estimators*

The TWFE DiD estimator is potentially biased when the treatment effect varies over time or across states. Goodman-Bacon (2021) demonstrates that this estimator is a weighted average of all possible two-group and two-period difference in differences estimators, where comparisons are

[28] We also find evidence that pre-trends were parallel, where the p-value is 0.419 of the test whose null is that the pre-trend coefficients are jointly zero (Borusyak et al. 2021).

problematic between states that implemented merit aid earlier versus later in the presence of differential treatment effects over time or across states.[29] To test for potential bias in our estimates, we perform the decomposition from Goodman-Bacon (2021) which shows how the overall point estimate is the weighted sum of timing effects and never versus treated groups.[30] Appendix table A5 shows that our estimates stem almost exclusively from comparisons of states with merit aid programs to states with no merit aid programs (treated vs. never treated), comprising around 97 percent of the weight. This is reassuring because comparisons of the never-treated versus treated groups are the theoretically cleanest estimands. Thus, our TWFE DiD estimates likely are not affected by issues raised in Goodman-Bacon (2021).

To test the robustness of our findings, we use four alternative estimators where each estimator accommodates the possibility of differential treatment effects across time and state, thus avoiding the problematic comparisons of the TWFE DiD estimator. Even though the econometrics literature has not settled on the best estimator yet, Baker, Larcker and Wang (2021) show that each alternative estimator recovers the true treatment effect.[31] We find that our TWFE DiD estimates of the effect of merit aid on labor supply are robust to all four alternative estimators.

First, we implement a stacked regression (Cengiz et al. 2019, Baker et al. 2021), where we create a dataset for each state that implemented a strong merit aid program and all other states that did not implement a strong program. Then, we stack these nine data sets in relative time to calculate an average effect across all 9 events using a single set of treatment indicators.[32] Second, we

[29] If the treatment effect is changing over time, this change in treatment effect among the already treated controls will be mistakenly included as part of the counterfactual time trend in outcomes.
[30] To perform this decomposition we had to: aggregate our individual-level data to be state-level, use balanced panels and exclude covariates.
[31] Each alternative estimator uses different comparison units.
[32] We use equation (1), but interact state and year fixed effects with indicators for the specific stacked dataset.

implement a two-step estimation strategy from Callaway and Sant'Anna (2021), which conducts asymptotically valid inference that adjusts for autocorrelation and clustering.[33] Third, we also implement the efficient imputation estimator developed in Borusyak et al. (2021). Fourth, we implement the estimator from de Chaisemartin and d'Haultfœuille (2020) which focuses on instantaneous treatment effects.[34]

Figure 2 shows the effect of merit aid on hours of work for all mothers of college-age children using the TWFE DiD estimator (equation 1), and the alternative estimators: stacked (Cengiz et al. 2019), Callaway and Sant'Anna (2021), Borusyak et al. (2021) and de Chaisemartin and d'Haultfoeuille (2020). The coefficients across all estimators are on similar trends and are of similar magnitudes. All estimators show a drop in hours of work after merit aid start.[35] Table 4 shows a summary of all coefficients, representing the effect of merit aid 1 to 11 years after its introduction, where treatment effects are remarkably similar across all estimators.[36]

Based on the results of the decomposition exercise from Goodman-Bacon (2021) and the similarity of coefficients across all alternative estimators, in our case it is reasonable to use the TWFE DiD estimator. Thus, we continue to use the TWFE DiD estimator for the rest of the paper.

### *E. Results: Intensive and 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). For the extensive margin, we examine the employment status,

[33] For this estimation, we aggregate our individual-level data to be state-level.
[34] Not all estimators allow for covariates, so we implement model 1 in all alternative estimators. Our results are robust to adding covariates (see tables A3, A4, A7 to A9, and A11). The omitted pre-period is event years -6 to -5 in Borusyak et al. (2021), Callaway and Sant'Anna (2021), and de Chaisemartin and d'Haultfœuille (2020), and is event years -2 to -1 in TWFE DiD and stacked models.
[35] See table A6 for these coefficients and their standard errors.
[36] We cannot provide this estimate using the method from de Chaisemartin and d' Haultfœuille (2020), because it can only estimate instantaneous treatment effects, and not effects 1 to 11 years after merit aid start.

while for the intensive margin we examine the hours of work for employed mothers.

The decline in hours of work was mostly a result of adjustment on the intensive margin. Figure 3 panel A shows mixed evidence of a change in employment status.[37]The coefficient in table 3 (panel B, column 4), even though negative is not statistically significant. In figure 3, the coefficient is negative, larger in magnitude 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.[38] Figure 3, panel B, shows a drop in hours of work among employed mothers after merit aid started, providing evidence for an intensive-margin adjustment.[39] 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 relative to the pre-treatment mean.

### *F. Results: Maternal Labor Supply by College-going Status of Children*

Because only children of parents of college-going children are eligible for merit aid, we test whether the decline in hours of work is concentrated among mothers of children who attend college. In addition, we do not expect responses among mothers without college-going children, our placebo group.

One potential concern is that merit aid also affects the college-going decision, resulting in

[37] We find evidence of parallel pre-trends from the p-value equaling 0.57, when testing whether the pre-trend coefficients are jointly zero (Borusyak et al. 2021).
[38] In section VI, table 7 shows no heterogeneity of employment responses among advantaged and disadvantaged mothers, while effects on hours of work are entirely concentrated among advantaged mothers. This further suggests a lack of conclusive evidence of an effect at the extensive margin.
[39] Again, we find evidence of parallel pre-trends, where we cannot reject the null that there are no pre-trend differences (Borusyak et al. 2021), where the p-value equals to 0.57.

mechanical changes in labor supply due to the change in the composition of parents of college-going children. As previously discussed, the literature has mixed findings on the effect of merit aid on college enrollment and attainment (Dynarski 2004, Cornwell et al. 2006, Goodman 2008, Fitzpatrick and Jones 2016, and Sjoquist and Winters 2015b). 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 small.

As expected, the decline in hours of work was due to adjustments among mothers who have college-going children. Panel A of figure 4 shows a notable decline in hours of work after merit aid programs started among mothers of college-going children.[40] Table 5 (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 4 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 – our placebo group. Moreover, table A10 shows that these results are robust to alternative estimators that take into account heterogeneous treatment effects.

Similar to the sample of mothers of college-age children, we mostly find evidence that the

[40] We find evidence of parallel pre-trends trends, where the p-value is 0.34 for the null hypothesis that the pre-trend coefficients are jointly equal to zero (Borusyak et al. 2021).

decline in hours of work happened at the intensive margin for mothers of college-going children. Table 5 (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 relative to the pre-treatment mean.

### *G. Placebo Test: Mothers with Youngest Child Older than College Age*

We also analyze the effect of merit aid on the labor supply of mothers whose children went to college but whose youngest child is older than college age (ages 26 to 33 in our case). Because their children are unlikely receiving merit aid, analysis of this group of mothers serves as a placebo test.[41] Table A13 shows no evidence of an effect on hours of work among mothers whose youngest children are older than college-age. This result bolsters the internal validity of our estimates and the interpretation that the decline in labor supply was due to merit aid.

## V. Effects per Dollar of Merit Aid Spending

In the previous section, we estimated the effect of the introduction of a strong state merit aid program on maternal labor supply. In this section, we estimate the effect per dollar of merit aid spending, by using annual data on merit aid spending per full-time equivalent undergraduate student in each state. Figure A1 shows that merit aid spending in a state increases substantially after the introduction of a strong merit aid program, while table 1 documents the variation in the generosity of merit aid programs. Relying on the same identification assumptions from our TWFE DiD framework, we follow Isen, Rossin-Slater, and Walker (2017)'s strategy by using the introduction of merit aid programs in each strong state as an instrument for merit aid spending.[42]

[41] To ensure that our placebo group is not affected by merit aid, we present effects averaged over 4 years after merit aid start (compared to 11 years after in the main analysis). Mothers with youngest children out of college now could be affected by merit aid in the past, when children were in college, the more years have passed since merit aid start.
[42] Isen et al. (2017) instrument for changes in air pollution using the introduction of the Clean Air Act of 1970.

The first-stage regression in this two-stage least squares (2SLS) estimator is a difference-in-differences regression model:

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

where $Merit_{i,s,t}$ is merit aid spending per 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 equation (1). The coefficient of interest is $\alpha_2$, providing an estimate of the effect of the introduction of merit aid on spending in the years after the introduction.

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

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

The coefficient of interest, $\beta$, shows the effect on maternal labor supply per dollar of merit aid spending per undergraduate student, $Y_{i,s,t}$. In all regressions, we report the Montiel Olea-Pflueger (2013) F-test for weak instruments.[43]

The exclusion restriction to identify $\beta$ is equivalent to assumptions necessary for the internal validity of the TWFE framework in section IV.[44] Several pieces of evidence support the validity of our exclusion restriction. First, estimates in figures 1, 2, 3, and 4 (section IV) 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

[43] Note that the F-test proposed by Montiel Olea-Pflueger (2013) is equivalent to the Kleibergen-Paap F-test in our framework where we have one endogenous variable and one instrument.
[44] This is equivalent to the assumptions maintained in Isen et al. (2017).

A2 provided evidence that the composition of mothers of college-age and college-going children did not change after merit aid programs. Finally, our placebo test does not find evidence of an effect per dollar of merit aid spending among mothers whose children did not attend college.

First, we present evidence for the first-stage relationship between merit aid start and spending. The estimates in appendix table A14 correspond to estimates of $\alpha_2$ in equation (2) and support a strong relationship between merit aid start and 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 spending per FTE 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 FTE undergraduate student.[45]

Once we incorporate differences in program size, we still find that increasing merit aid is associated with decreases in maternal labor supply. Table 6 (panel A) presents estimates from equation (3) among mothers of college-age children. A $1 increase in merit aid spending per undergraduate student is associated with a reduction of 0.146 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) is associated with a 1 percent decline in hours of work (-0.146*109.4/1,567).[46] As in the TWFE framework, most of the adjustment in hours of work is at the intensive margin. The coefficients in Table 6 (panel A) on the employment status are small and statistically insignificant.

As in the TWFE framework, the decline in hours of work is entirely due to mothers of college-going children. Table 6 (panel B) presents estimates from equation (3) among mothers of college-going children. A $1 increase in spending per undergraduate student is associated with a

[45] 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.
[46] The pre-treatment mean hours of work is 1567, as presented in panel A of table 3.

reduction of 0.199 hours of work among mothers of college-going children. Thus, a 10 percent increase in spending ($112.5 = 0.1*$1,125) is associated with a 1.35 percent decline in hours of work (-0.199*112.5/1,659). However, appendix table A12 (panel B) shows no evidence of effects of merit aid on hours of work among mothers who never had a college-going child – our placebo test.

In sum, we find similar results using the TWFE DiD strategy (equation 1), and when we estimate effects per dollar of merit aid spending (equation 3). For convenience of interpretation, the next sections present effects per dollar of merit aid spending (equation 3). Importantly, all results in the next section also go through using the TWFE DiD strategy (equation 1).

## VI. Heterogeneous Effects of Merit Aid Programs

We compare the effects of merit aid for advantaged and disadvantaged mothers, and for mothers by number of children in college. We define advantaged mothers as those who are married, have at least some college education, and are white. We compare different groups of mothers: (1) married and single, (2) completed at least some college and completed high school or less, (3) white and non-white, (4) with one and at least two children in college at the same time.

### *A. Comparison of Advantaged and Disadvantaged Mothers*

It is ambiguous whether advantaged or 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, and Farrell 2004). 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 family net worth. Third, the children of

advantaged women are less likely to be eligible for other forms of financial aid, while most disadvantaged students receive other financial aid that can, at least in part, cover tuition and fees.[47] For disadvantaged children, merit aid may be displaced by other financial aid resulting in smaller changes in the cost of college relative to advantaged mothers (Scott-Clayton 2017). 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, more educated, and white mothers. Importantly, these conclusions hold for both mothers of college-age and college-going children. Finally, there is no conclusive evidence of a change in the employment status among advantaged and disadvantaged mothers. Table 7 summarizes coefficients from the instrumental-variables framework (equation 3) for mothers of college-going children.[48] These tables present estimates from our preferred specification (model 4) that includes the full set of covariates in equation (3).

First, the decline in labor supply is due to married mothers. 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.[49] A 10 percent increase in merit aid spending is associated with a 1.6 percent (-0.262*0.1*1,125/1,822) decrease in hours of work among married mothers of college-going children (table 7, panel A, column 1). We find no evidence of adjustments among unmarried women where the coefficient is small and statistically insignificant. These findings are

[47] Of the lowest-income students, 58% got enough aid to cover their tuition (College Board 2018).
[48] Table A15 presents findings for mothers of college-age students; conclusions are similar to table 7.
[49] Our sample only includes individuals listed as either heads or spouses.

consistent with the literature showing that married mothers are more responsive to income transfers than single mothers (Eissa and Hoynes 2004, Feinberg and Kuehn 2018, Koebel and Schirle 2016, and Powell 2020).

Second, the decline in labor supply is due to more educated mothers. We compare labor supply responses of mothers who have some college education and mothers who do not. A 10 percent increase in merit aid spending is associated with a 1.7 percent (-0.280*0.1*1,125/1897) decline in hours of work among mothers of college-going children (table 7, panel A, column 3). We find no evidence of adjustments among less educated women where the coefficient is small and statistically insignificant.

Third, the decline in labor supply is due to white mothers. A 10 percent increase in merit aid spending is associated with a 1.4 percent (-0.239*0.1*1,125/1,873) decline in hours of work among white mothers (table 7, panel A, column 5). We find no evidence of adjustments among non-white mothers.

*B. Comparison of Mothers by Number of Children in College*

We now estimate the effect of merit aid by the number of children in college at the same time. Conditional on their total number of children, we expect women with more children in college to decrease their labor supply the most, because they can accumulate merit aid awards for many children. To test this hypothesis, we calculate the number of college-going children every year and estimate the effect of merit aid for two groups: mothers with one child in college and mothers with two or more.

Confirming the benefits of receiving multiple merit aid grants, we find that mothers with two or more children in college adjust their labor supply the most. Table 8 summarizes coefficients

from the instrumental-variables framework (equation 3) for mothers of college-going children.[50] Among mothers with one child in college, a 10 percent increase in merit aid spending per undergraduate student is associated with a 0.77 percent (-0.101*0.1*1,125/1467) decrease in hours worked, and no discernible effect on employment status. Among mothers with at least two children in college, a 10 percent increase in merit aid is associated with a 3.8 (-0.561*0.1*1,125/1660) percent decrease in hours worked, and a 1.7 percent decrease in employment among mothers with at least two children in college (-0.0135*0.1*1125/91).

## VII. Dynamic Effects of Merit Aid on Maternal Labor Supply

Previous sections have estimated the contemporaneous effects of merit aid on mothers while their children attended college. This section will shed light on the life-cycle dynamics of responses to merit aid programs. First, we investigate whether mothers of younger children respond to the introduction of merit aid. The introduction of merit aid should affects families' expectations regarding the future costs of their younger children. If families have no barriers to borrow, we expect that mothers would smooth out the response to the transfer by adjusting their labor supply even before children enter college. Next, we study the labor supply decisions of mothers in merit aid states once all their children leave college. If families discount future consumption, and have no barriers to save, we expect merit aid to have persistent effects on labor supply decisions of mothers even after their children leave college.

First, we test if mothers adjust their labor supply even before the first child starts college. Importantly, we conduct our analysis on the main sample of mothers of college-going children used in equation (3). We perform a variant of equation (3), where all variables are measured 1 to

[50] All regressions control for the total number of children.

2 years before the mother's first child attends college.[51] This is a deviation from equation (3), where all variables are measured as of year $t$ – when the mother has a child in college. The coefficient of interest measures the effect of a one-dollar increase in merit aid spending per undergraduate student 1 to 2 years before the first child enters college on the labor supply of mothers in that year.

We find suggestive evidence that mothers decrease their labor supply before their first child attends college, but this decline is smaller than the one while children are in college and not statistically significant. Table 9 shows that merit aid has a negative effect on hours of work 1 to 2 years before the first child attends college, where the coefficient on hours of work (-0.125; column 1) is 60 percent of the size of the coefficient in the years when a child attends college (table 6, panel A, column 4), but is not statistically significant. This coefficient provides suggestive evidence that mothers are forward looking.

Second, we test whether the decline in labor supply while children are in college persists even after the last child leaves college. Again, we conduct our analysis on the main sample of mothers of college-going children used in equation (3). We perform a variant of equation (3), where merit aid per full-time equivalent undergraduate student ($Merit_{i,s,t}$) is measured in year $t$ – when the mother has a child in college. However, all other variables are measured 1 to 2 years after the last child leaves college. The coefficient of interest measures the effect of a one-dollar increase in merit aid spending per undergraduate student in year $t$ on labor supply 1 to 2 years after the last child leaves college.

While the negative effect on maternal hours of work persists after all children leave college, it is smaller than the one while children are in college and is not statistically significant. Table 9

[51] Given that starting from 1997 the PSID is an every other year survey, we observe the mother 1 to 2 years before the first child attends college.

shows that merit aid has a negative effect on hours of work 1 to 2 years after the last child leaves college, where the coefficient on hours of work (-0.0971) is roughly half the size of the coefficient when the child attends college (table 6, panel A, column 4), but is not statistically significant. This provides suggestive evidence that while mothers decline their labor supply the most while children are in college, some of this decline may persist after children leave college.

One caveat of the dynamic effects analysis is that we do not observe outcomes for every mother of a college-going child before the first child enters college and after the last child leaves college. In fact, the samples in table 9 are necessarily smaller than in table 6 (panel B), because survey non-response rises as we track individuals for a longer period of time, or the time period of interest may be outside the scope of our sample from 1988 until 2015. This is a concern if the sample in the dynamic effects analysis changes in a way that is correlated with the treatment effect of merit aid. To test for potential bias, we perform the analysis in equation (3), while using the samples in the dynamic effects analysis in table 9. These coefficients present effects of roughly similar magnitude as in table 6. Thus, we do not find evidence that the changing sample in the dynamic effects analysis biases our results.

## VIII. Discussion

How do the employment responses among mothers compare to the size of the merit aid transfer? Accounting for the total effect of merit aid on families' finances is challenging due to the lack of information on who receives it in the PSID, the expected number of years and amount of the transfer, and monetary savings from a child not attending a more expensive out-of-state institution. Nonetheless, suggestive back of the envelope calculations provide evidence of the size of the loss in labor income by mothers in response to the merit aid transfer.[52] First, to calculate the

[52] See appendix C for the detailed calculations.

average transfer to the family, we estimate the expected merit aid award for each child participating in the program in a strong merit aid state ($5,784), the expected savings from a child not attending a more expensive out-of-state college ($1,199), and the average number of children in college in a given year for the families in our sample (1.27). Using these calculations, we estimate the average transfer each year to be around $8,868.

Second, we calculate the average decline in labor income among mothers the majority of whom benefited from merit aid. We focus on mothers who have college-going children, and who have attended college themselves, which is consistent with our empirical findings that the results are driven by advantaged women. The majority of these mothers likely benefited from merit aid and received the highest transfers both because their children were more likely to be eligible for merit aid, and less likely to be eligible for other financial aid displacing merit aid.[53] We use the estimate of the effect on hours of work among these mothers (315) and convert it into earnings by multiplying this effect by their hourly wage before merit aid programs started ($18.4). By doing this, we find that the maternal decline in earnings is $5,796.

Comparing the annual maternal decline in earnings in the years when a child is in college ($5,796) to the annual merit aid transfer ($8,868), we estimate that the maternal decline in earnings accounts for about 65 percent of the transfer. These estimates are consistent with female labor supply being more income elastic historically than male labor supply (Keane 2011, and Bargain and Peichl 2016).[54] How do our suggestive estimates compare to those in the literature on effects of exogenous unearned income shocks? On one hand, our estimates for mothers are in the same

[53] Our estimate of earnings lost could be a lower bound because not all advantaged children receive merit aid; our estimate of the merit aid transfer received could be a lower bound, because advantaged children receive higher transfers, than the average transfer to all recipients.
[54] However, recent work shows that married women's wage elasticities have declined over time in the United States (Blau and Kahn 2007, and Heim 2007).

range as the estimates of effects of income transfers to mothers during a child's early years; similarly, we do not find responses among fathers (Gonzalez 2013, Schirle 2015, and Wingender and LaLumia 2017).[55] Mothers of young children likely reduce labor supply because young children benefit the most from interactions with their mother. Our results provide novel evidence that child-related transfers continue to play a major role in maternal labor supply, even once children grow up. Our finding of responses *only* among mothers is of note, because income transfers when children transition to adulthood could affect the labor supply of both parents, as adult children require much less mother-specific and time-intensive care than immediately after birth. Our estimates are also in the same range as the estimate of the effect of welfare transfers on the labor supply of older workers, and consistent with stronger effects of welfare transfers on the labor supply of women than men (Giupponi 2019).[56]

Our estimates are larger than those found in the literature studying the effects of winning the lottery in Sweden (Cesarini et al. 2017), are in line with those in the United States (Golosov, Graber, Mogstad, and Novgorodsky 2021), and even though larger, are also in line with effects of the 2008 tax rebate in the United States (Powell 2020).[57] Moreover, our lack of an effect for fathers is in contrast to similar responses among men and women found in Cesarini et al. (2017), Golosov et al. (2021), and Powell (2020). Effects of unexpected changes in college costs may be different from an unexpected windfall of money, because families likely plan for future college costs by

[55] Gonzalez (2013; Spain) finds a 2,500 euro benefit at the birth of a child reduces female earnings by 700 euros in the following 12 months. Using estimates from Schirle (2015; Canada), we calculate that receiving $1,200 per year until the child is 6 reduces female yearly earnings by $1,040 while the child is under 6. Wingender and LaLumia (2017; United States) find that each additional dollar of tax benefits (December births tax break) reduces earnings in the year after birth by a dollar.

[56] Exploring changes in the generosity of survivor insurance in Italy, Giupponi (2019) estimates that earned income increases one-for-one with benefit losses.

[57] Cesarini et al. (2017) find that winning 1 million SEK reduces annual earnings by 11,000 SEK. Golosov et al. (2021) find that an extra dollar of unearned income in a given period reduces pre-tax labor earnings by about 50 cents. Powell (2020) estimates that earnings decline by 23 cents per rebate dollar.

adjusting savings earlier in life. Also, lottery players may not be representative of the overall population, and labor supply responses may differ after increases in other income.

## IX. Conclusion

This study documents a meaningful link between a child's transition to adulthood and the labor supply of mothers, but not of fathers. We find that mothers of college-going children decrease their annual hours of work after the start of merit aid programs in their state of residence. A 10 percent increase in merit aid spending per undergraduate student is associated with a 1.3 percent reduction in hours of work among mothers of college-going children. Almost the entire decline in labor supply stems from married, more educated, and white mothers, either because these advantaged mothers disproportionately benefit from merit aid programs, or because their labor supply is more elastic. Further, mothers with multiple children in college, and thus expected to receive larger transfers, experience the largest reductions in working hours. In terms of the dynamic responses to merit aid, we find suggestive evidence that mothers lower their labor supply right before the first child attends college and right after the last child leaves college, but these effects are substantially lower than while children are in college and are not statistically significant.

This paper provides a novel contribution on the literature relating childbirth to female labor supply. While it is well-known that young children are one of the most important deterrents of female labor supply, this study provides the first causal evidence that adult children influence labor supply later in life. Even though adult children require less time-intensive and mother-specific care, it is of note that in our setting, changes in their costs do not affect the labor supply of fathers.

Our findings suggest that mothers adjust their labor supply in a similar way to adult-child related transfers, as to young-child related transfers. Do we expect this? On one hand, the labor supply of mothers with young 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 childcare options. On the other hand, the labor supply of mothers with adult children may be more responsive, because they are closer to retirement and may face lower penalties for career interruptions (Miller 2011).

Finally, this study underscores the importance of considering the potential effects of making college more affordable on the whole family, as the college-affordability debate is gaining political traction. While previous literature has evaluated the effect of college costs on children's outcomes (Kane 2006, and Page and Scott-Clayton 2016), it has largely ignored their potential effects on parental labor supply. Effects can be economically meaningful, because college costs represent a major expense for families with a college-going child.

In addition, this study underscores the importance of considering who would benefit from lower college costs. In the case of merit aid, more advantaged families were the primary beneficiaries of this aid, which is undoubtedly an important explanation of why we only find adjustments in labor supply among advantaged mothers. Thus, in designing programs that lower college costs, it is important to keep in mind that effects on families depend critically on what types of families benefit from reductions in college costs the most.

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## Table 1. States with Strong Programs Implemented

| State | First Year | Program Name | Annual state merit grant aid per full-time-equivalent undergraduate student in 2012 | % of 18-22 undergraduate students receiving state merit aid in 2011 | Maximum merit aid as percentage of tuition and fees in public four-year institutions in 2012 |
|---|---|---|---|---|---|
| Florida | 1997 | Florida Bright Futures Scholarship | $482 | 24.1 | 72.0 |
| Georgia | 1993 | Georgia HOPE Scholarship | $2,538 | 34.5 | 73.0 |
| Kentucky | 1999 | Kentucky Educational Excellence Scholarship | $921 | 50.7 | 29.0 |
| Louisiana | 1998 | Louisiana TOPS Scholarship | $1,616 | 26.5 | 112.0 |
| Nevada | 2000 | Nevada Millennium Scholarship | $375 | 25.8 | 42.0 |
| New Mexico | 1997 | New Mexico Lottery Success Scholarship | $1,364 | 29.2 | 80.0 |
| South Carolina | 1998 | South Carolina LIFE Scholarship | $2,641 | 41.2 | 68.0 |
| Tennessee | 2004 | Tennessee HOPE Scholarship | $1,814 | 35.0 | 95.0 |
| West Virginia | 2002 | West Virginia PROMISE Scholarship | $753 | 20.6 | 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, IPEDS and the National Postsecondary Student Aid Study (NPSAS:12).

**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, we 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 paired event year dummies are replaced with dummies for paired 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 paired 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; the sample includes all states for which data are available in the PSID (49 states). 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. Robustness of TWFE DiD: Effect of Merit Aid on Maternal Annual Hours of Work**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **TWFE DiD** | **Borusyak et al. (2021)** | **Callaway and Sant'Anna (2021)** | **Stacked (Cengiz et al. 2019)** |
| | *A. Mothers with College-age Child* | | | |
| After Merit Aid | -160.6 | -156.9 | -141.2 | -168.8 |
| | [70.07]** | [39.44]*** | [40.71]*** | [65.39]** |
| | *B. Mothers with College-going Child* | | | |
| After Merit Aid | -221.2 | -216.7 | -239.7 | -227.5 |
| | [90.60]** | [47.34]*** | [115.06]** | [82.56]*** |

Notes: These estimates present the effect of merit aid on annual hours of work of mothers of college-age children (panel A) and college-going children (panel B) over 12 years after the start of merit aid. Column 1 presents the estimate from equation 1 from the TWFE DiD; column 2 presents the estimate from Borusyak et al. (2021); column 3 presents the estimate from Callaway and Sant'Anna (2021); column 4 presents the estimate from the stacked model. All estimates are for model 1. In the Callaway and Sant'Anna (2021) method, we aggregate the individual-level data to be at state-level.

**Table 5. 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 | -244.0 | -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 6. Effect of Merit Spending per Full-time Equivalent (FTE) Undergraduate Student on Employment Outcomes of Mothers by Child's College-going Status**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| **A. Mothers of College-age Children** | | | | |
| *1. 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 |
| *2. Dependent Variable: Employment Status* | | | | |
| 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 |
| *3. 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 |
| **B. Mothers of College-going Children** | | | | |
| *1. Dependent Variable: Annual Hours of Work* | | | | |
| Merit spending per FTE student | -0.161 | -0.19 | -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 |
| *2. Dependent Variable: Employment Status* | | | | |
| 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 |
| *3. Dependent Variable: Annual Hours of Work if Employed* | | | | |
| Merit spending per FTE student | -0.098 | -0.13 | -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 |
| 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) for mothers of college-age children (panel A), and for mothers of college-going children (panel B). We use an indicator for the period after merit aid in strong states as an instrumental variable. Montiel Olea-Pflueger 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 7. 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 | -0.0300 | -0.239 | -0.0613 |
| | [0.123]** | [0.110] | [0.171] | [0.139] | [0.118]** | [0.0939] |
| Observations | 5,067 | 2,823 | 3,631 | 4,009 | 4,060 | 3,830 |
| Pre-treatment Mean | 1822 | 1199 | 1897 | 1283 | 1873 | 957.9 |
| First-stage F-statistic | 15.22 | 21.88 | 11.03 | 34.57 | 14.38 | 27.49 |
| *B. Dependent Variable: Employment Status* | | | | | | |
| Merit per FTE Student | -0.00267 | -0.00291 | -0.00338 | -0.00406 | -0.00230 | -0.00492 |
| | [0.00435] | [0.00453] | [0.00420] | [0.00611] | [0.00352] | [0.00521] |
| Observations | 5,067 | 2,823 | 3,631 | 4,009 | 4,060 | 3,830 |
| Pre-treatment Mean | 89 | 73.43 | 92.45 | 73.66 | 91.80 | 62.49 |
| 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. 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 6.

**Table 8. Effect of Merit-Aid by Number of College-Going Children**

| | (1) | (2) |
|---|---|---|
| | **1 child** | **2+ children** |
| *A. Dependent Variable: Annual Hours of Work* | | |
| Merit per FTE Student | -0.101 | -0.561 |
| | [0.0612]* | [0.229]** |
| Observations | 6,171 | 1,719 |
| Pre-treatment Mean | 1621 | 1949 |
| First-stage F-statistic | 17.17 | 11.04 |
| *B. Dependent Variable: Employment Status* | | |
| Merit per FTE Student | -0.00208 | -0.0135 |
| | [0.00302] | [0.00725]* |
| Observations | 6,171 | 1,719 |
| Pre-treatment Mean | 83.09 | 98.93 |
| First-stage F-statistic | 17.17 | 11.04 |

Notes: The estimates present the effect of merit aid spending per full-time equivalent undergraduate student on annual hours of work (panel A) and employment status (panel B) for mothers of college-going children using an indicator for the period after merit aid introduction in strong states as an instrumental variable. Column (1) includes women who have 1 child enrolled in college in year *t* (at the same time). Column (2) includes women who have 2 or more children enrolled in college in year *t*. The estimates are from model (4), which is our baseline specification that includes all co-variates. See notes for table 6.

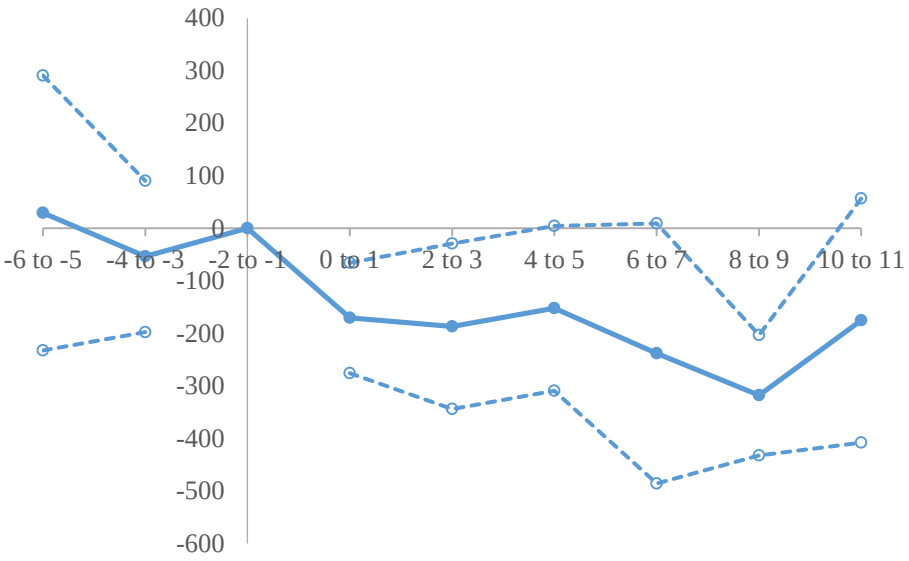
**Table 9. Dynamic Effects of Merit Aid on Maternal Annual Hours of Work**

| | (1) | (2) |
|---|---|---|
| | **1 to 2 years before first child in college** | **1 to 2 years after last child in college** |
| *A. Dependent Variable: Annual Hours of Work* | | |
| Merit per FTE Student | -0.125 | -0.0971 |
| | [0.145] | [0.145] |
| Observations | 6,295 | 5,689 |
| Pre-treatment Mean | 1485 | 1405 |
| First-stage F-statistic | 32.69 | 13.49 |
| *B. Dependent Variable: Employment Status* | | |
| Merit per FTE Student | -0.00137 | -0.00612 |
| | [0.00574] | [0.00634] |
| Observations | 6,295 | 5,689 |
| Pre-treatment Mean | 85.05 | 80.45 |
| First-stage F-statistic | 32.69 | 13.49 |

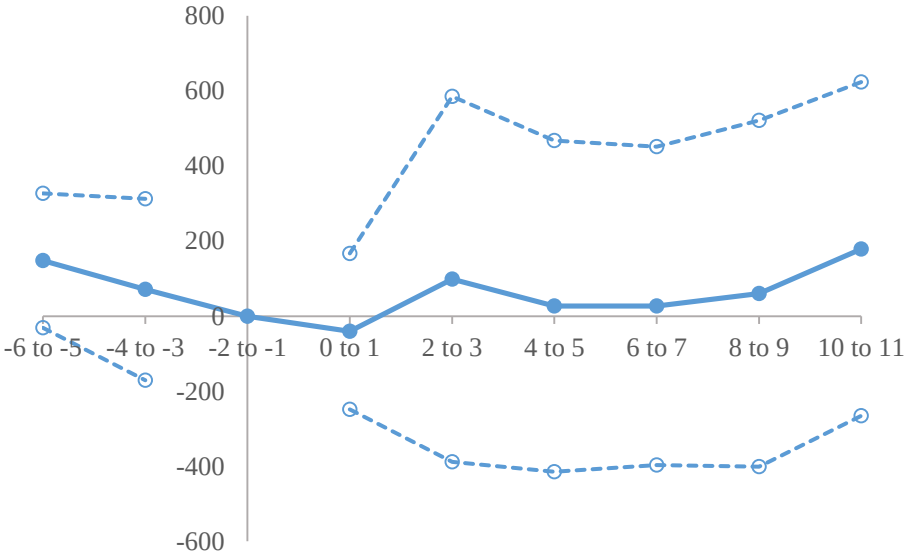
Notes: Column (1) presents the effect of merit aid spending per full-time equivalent undergraduate student 1 to 2 years before the first child enters college on annual hours of work in that year. Estimates in column (2) present estimates of the effect of merit aid spending per full-time equivalent undergraduate student in the year when the child is in college on annual hours of work 1 to 2 years after the last child leaves college. These regressions are for the sample of women who have a college-going child in table 6. The estimates are from model (4), which is our baseline specification that includes all co-variates. See notes for table 6.

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

*A. Mothers of College-Age Children*

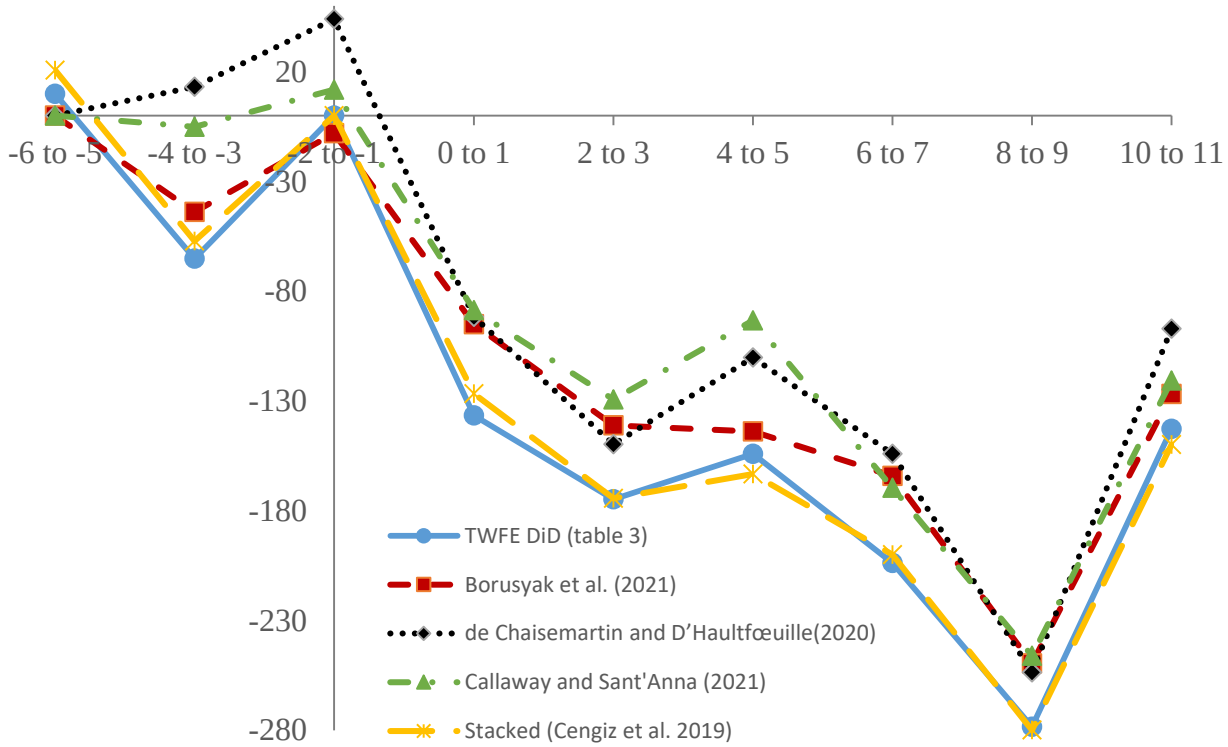



*B. Fathers of College-Age Children*




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 paired 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.

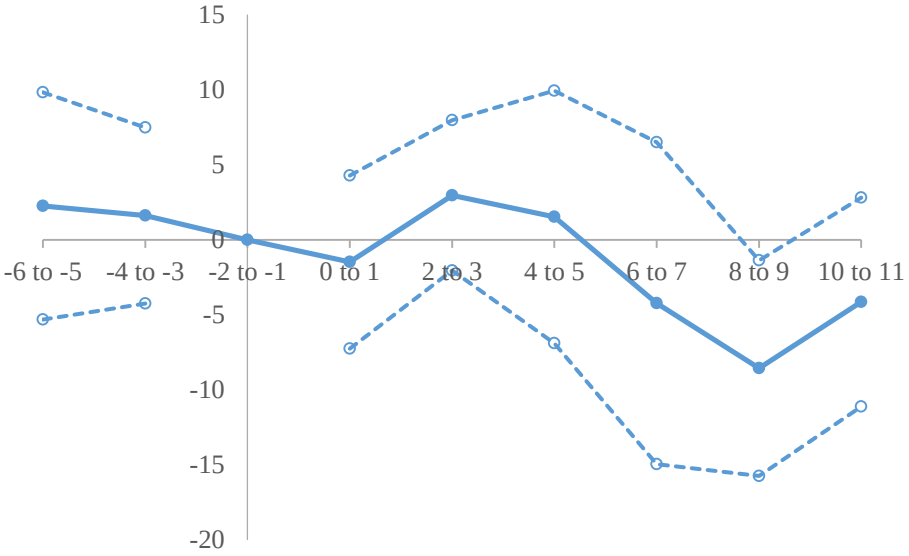
**Figure 2. Robustness of TWFE DiD: Effect of Merit Aid on Annual Hours of Work of Mothers with College-Age Children**



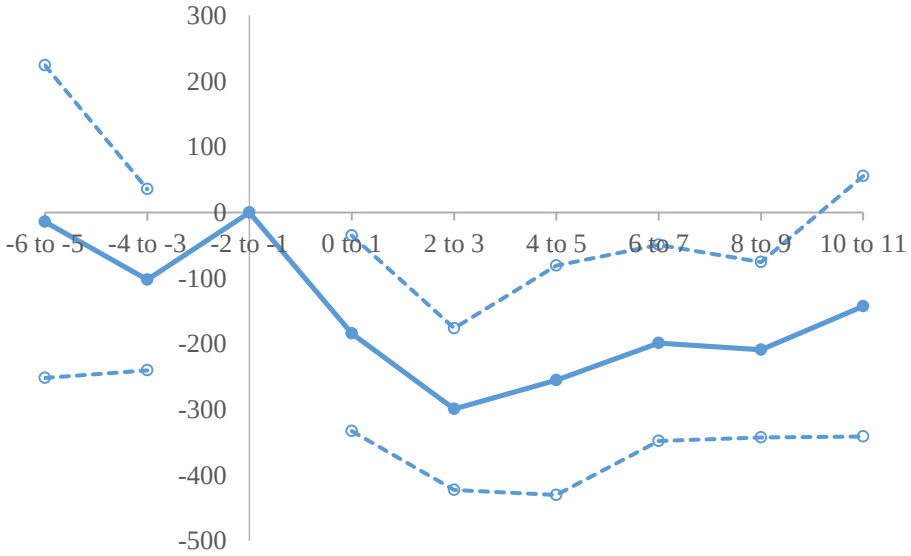

Notes: These are estimates of the effect of merit aid on annual hours of work of mothers with college-age children. The solid line with circles is the estimate from the two-way fixed effects difference-in-differences (TWFE DiD) model presented in table 3 (column 1). The dashed line with crosses is the stacked model (Cengiz et al. 2019). The dashed line with squares is the Borusyak et al. (2021) model. The dashed line with triangles is from Callaway and Sant'Anna (2021). The dashed line with diamonds is from de Chaisemartin and D'Haultfoeuille (2020). All estimates are from model 1 without covariates. In the Callaway and Sant'Anna (2021) method, we aggregate the individual-level data to be at state-level. The omitted pre-period is event years -6 to -5 in Borusyak et al. (2021), Callaway and Sant'Anna (2021), and de Chaisemartin and d'Haultfœuille (2020), and is event years -2 to -1 in TWFE DiD and the stacked model.

**Figure 3. Effect of Merit Aid on Employment Outcomes of Mothers of College-Age Children**

*A. Employment Status*



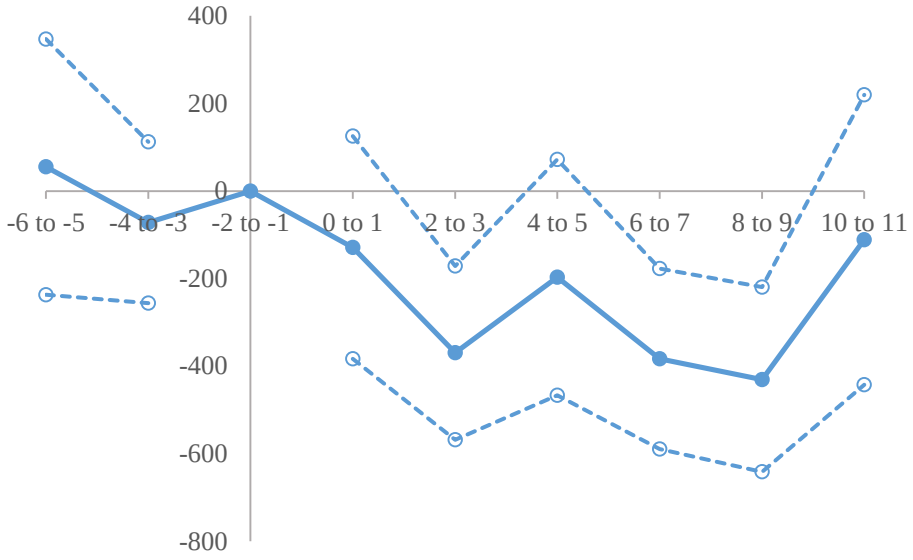

*B. Hours of Work if Employed*



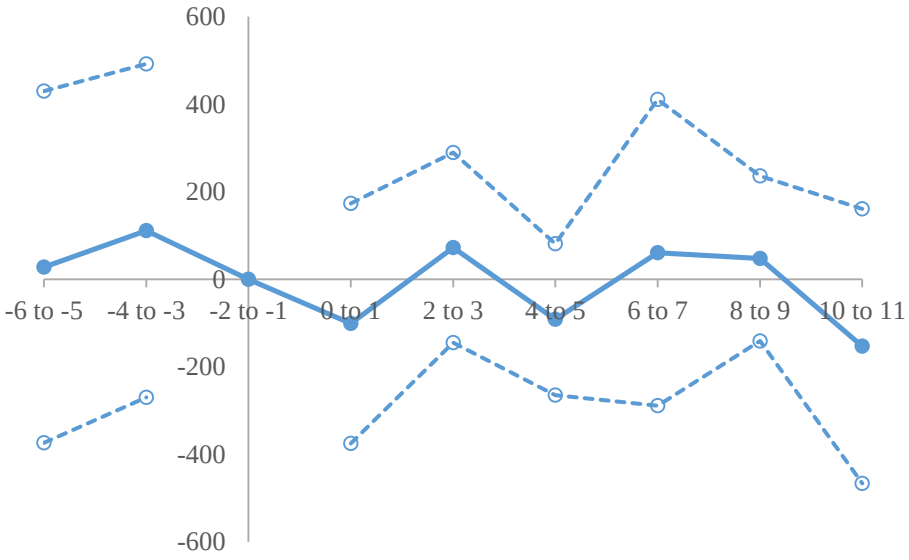

Notes: The graphs present the evolution of employment status (Panel A) and annual hours of work of those employed (Panel B) before and after merit aid programs for women with college-age children using equation (1). See notes and sources for figure 1.

**Figure 4. 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. Goodman-Bacon (2021) Decomposition**

| Difference in Differences Comparison | (1) Weight | (2) Average DiD Estimate |
|---|---|---|
| Earlier Treated vs. Later Treated Controls | 0.016 | -68.2 |
| Later Treated vs. Earlier Treated Controls | 0.005 | -70.2 |
| Treated vs. Never treated | 0.979 | -160.7 |

Notes: The table presents results of the decomposition developed in Goodman-Bacon (2021). Column (1) gives the weight in the estimation of the treatment effect that is given to each comparison, and column (2) gives the estimated treatment effect implied by each comparison. For this estimation, we aggregate the individual-level data to be at state-level.

**Table A6. Robustness of TWFE DiD: Effect of Merit Aid Programs on Annual Hours of Work of Mothers of College-Age Children**

| | (1) Borusyak et al. (2021) | (2) Callaway and Sant'Anna (2021) | (3) Stacked (Cengiz et al. 2019) | (4) de Chaisemartin and d'Haultfœuille (2020) |
|---|---|---|---|---|
| *Before Merit Aid Event Years* | | | | |
| -6 to -5 | 0 | 0 | 20.77 | 0 |
| | | | [132.1] | |
| -4 to -3 | -43.84 | -5.09 | -57.15 | 13.20 |
| | [159.77] | [105.36] | [73.94] | [169.82] |
| -2 to -1 | -7.98 | 11.87 | 0 | 44.06 |
| | [176.29] | [78.10] | | [99.60] |
| *After Merit Aid Event Years* | | | | |
| 0 to 1 | -95.05 | -88.61 | -126.6 | -91.64 |
| | [63.10] | [57.19] | [41.58]*** | [130.90] |
| 2 to 3 | -141.12 | -129.31 | -174.3 | -149.62 |
| | [78.43]* | [67.56]* | [54.28]*** | [142.45] |
| 4 to 5 | -143.85 | -93.24 | -163.2 | -110.17 |
| | [124.84] | [68.25] | [73.57]** | [240.29] |
| 6 to 7 | -164.16 | -169.48 | -199.9 | -154.00 |
| | [98.36]* | [111.68] | [110.3]* | [142.87] |
| 8 to 9 | -249.50 | -246.02 | -279.9 | -253.54 |
| | [60.51]*** | [95.66]*** | [87.16]*** | [163.76] |
| 10 to 11 | -126.74 | -120.66 | -149.8 | -96.98 |
| | [120.56] | [118.95] | [90.77]* | [181.30] |

Notes: Each column represents a method, where the paper that develops or uses the method is cited. The estimates are for model 1. Columns 1, 3 and 4 use individual-level data, while column 2 uses state-level data as required by the method.

**Table A7. 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 A8. 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 A9. 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 A10. Robustness of TWFE DiD: Effect of Merit Aid Programs on Annual Hours of Work of Mothers with College-Going Children**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | **Borusyak et al. (2021)** | **Callaway and Sant'Anna (2021)** | **Stacked (Cengiz et al. 2019)** | **de Chaisemartin and d'Haultfœuille (2020)** |
| *Before Merit Aid Event Years* | | | | |
| -6 to -5 | 0 | 0 | 72.14 | 0 |
| | | | [151.2] | |
| -4 to -3 | -152.01 | -175.95 | -104.9 | -136.13 |
| | [159.77] | [167.03] | [82.34] | [169.82] |
| -2 to -1 | -55.98 | 92.90 | 0 | 160.84 |
| | [176.29] | [89.31] | | [99.60] |
| *After Merit Aid Event Years* | | | | |
| 0 to 1 | -67.11 | -107.59 | -89.94 | -95.58 |
| | [63.10] | [151.84] | [156.9] | [130.90] |
| 2 to 3 | -293.56 | -338.90 | -330.4 | -352.74 |
| | [78.43]*** | [109.98]*** | [105.9]*** | [142.45]** |
| 4 to 5 | -129.42 | -114.71 | -154.4 | -126.32 |
| | [124.84] | [186.70] | [206.5] | [240.29] |
| 6 to 7 | -290.98 | -366.10 | -330.2 | -346.02 |
| | [98.36]*** | [159.42]** | [140.5]** | [142.87]** |
| 8 to 9 | -359.04 | -391.33 | -379.2 | -436.95 |
| | [60.51]*** | [163.21]** | [164.0]** | [163.76]*** |
| 10 to 11 | -77.08 | -106.77 | -89.11 | -73.48 |
| | [120.56] | [171.51] | [141.5] | [181.30] |

Notes: See notes for table A6.

**Table A11. 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 A12. 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 6 for panel B.

**Table A13. Effect of Merit Aid Programs on Hours of Work of Mothers with Youngest Children Older than College-Age**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| After Merit Aid | 145.3 | 1.019 | 0.576 | -15.2 |
| | [250.7] | [217.5] | [210.4] | [222.6] |
| Covariates | FE: State, Year | FE: State, Year; Xind | FE: State, Year; Xind; Xeduc | FE: State, Year; Xind; Xeduc; Xmacro |
| Observations | 4,179 | 4,179 | 4,179 | 4,179 |
| Pre-treatment Mean | 1357 | 1357 | 1357 | 1357 |

Notes: These present coefficients from equation (1), where estimation is for the sample of mothers of college-going children, whose youngest child is age 26 to 33. This estimates the effect of merit aid 1 to 4 years after merit aid introduction.

**Table A14. 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.

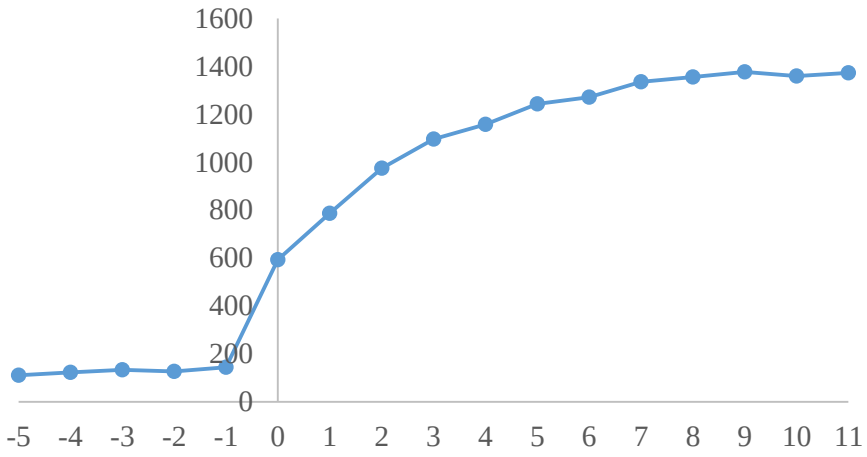
**Table A15. Heterogeneous Effect of Merit Aid Spending per Full-Time-Equivalent Student on Employment Outcomes of Mothers with a College-Age Child**

| | (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-going 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 6.

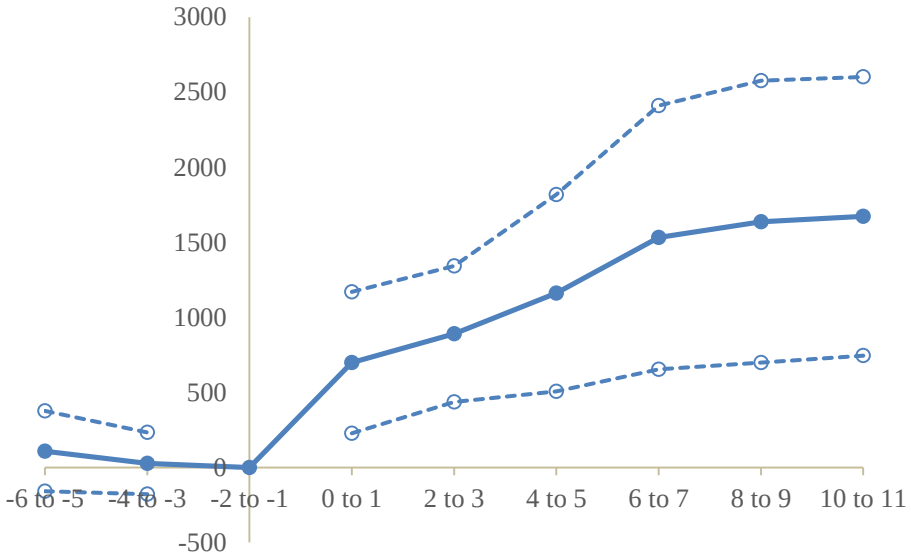
**Figure A1. Merit Aid Spending and Eligibility before and after Program Start**

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




Notes: The graph represents the evolution of merit aid spending (in 2015 dollars) per full-time-equivalent undergraduate student, 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: NASSGAP Annual Reports, IPEDS.

**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 any of the conditions listed below (1 to 4) are met*:

(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 any of the conditions listed below (1 to 4) are met:*

(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.

## APPENDIX C

*Calculation of the average yearly transfer.*

We calculate the average merit aid transfer in our sample to be $5,784 in a given year per child. We calculate the average merit aid transfer per full-time equivalent student in paired event years 1 to 6 that we use in our sample using NASSGAP data. We calculate the share of undergraduate students receiving merit aid using the Frisvold and Pitts (2018) data in paired event years 1 to 6 that we have in our sample. Finally, we divide the first number by the second number.

Second, we calculate the expected out-of-state tuition saved by each child to be $1,199. First, we calculate the average in-state tuition in strong merit aid states in 2012, as the weighted average of the in-state public tuition and private tuition in these states (using enrollment as weights) to be $9,793. We use IPEDS data for these calculations. Second, we calculate average out of state tuition in non-strong states as the weighted average of the out-of-state public and private tuition (using enrollment as weights) to be $23,114. The out-of-state tuition saved to be the difference between the average out-of-state tuition and fees and the average in-state tuition and fees: 23,114-9,793=13,321. Finally, we calculate the expected tuition saved taking into account that 9 percent of children would have attended college out-of-state without merit aid (Zhang and Ness 2010): 0.09*($13,321)= $1,199

Finally we calculate that an average family with college-going children had 1.27 children enrolled in college at the same time. We use the PSID data on our sample of college-going and more educated mothers to calculate this number. Thus the average transfer is: 1.27 *($5,784+$1,199)=$8,898.

*Calculation of Lost Earnings*

We use our estimate in table 7 of -0.28 for mothers of college-going children who themselves have some college education, and convert it into an average decline in hours among these women to be -315 (1125*-0.28). We use the PSID to estimate the average wage of these women before merit aid programs started to be $18.4. Thus, the average decline in labor income is: 315*18.4=$5,796.