National and State Estimates of the Costs and Benefits of Single Mothers' Educational Attainment to Individuals, Families, and Society: Methodological Appendix

Introduction

The Institute for Women's Policy Research's (IWPR) briefing paper, *Investing in Single Mothers' Higher Education: National and State Estimates of the Costs and Benefits of Single Mothers' Educational Attainment to Individuals, Families, and Society*, features findings from a study to quantify the individual and societal costs and benefits of single mothers' attainment of college degrees (see Reichlin Cruse et al. 2019). This work builds off of previous IWPR research on investments in single mothers' education (see Gault, Milli, and Reichlin Cruse 2018), adapting it to an analysis at the state level.[1]

In addition to the state-level focus, IWPR's 2019 briefing paper improves upon the previous report in several key ways: it estimates the impact of college education on lifetime public assistance receipt among single mothers (the previous report estimated the effect over a four-year period); it includes a new analysis of the impact of some college credit on outcomes among single mothers, even though they did not obtain a degree; and with the addition of the some college analysis, we are now able to estimate the full return on investment in support services for single mother students. These improvements, along with the remainder of the analysis, are discussed in greater detail in the sections below.

IWPR drew on existing literature and new calculations utilizing an array of data sources for its study. These sources include the 2015-2017 American Community Survey (ACS; Ruggles et al. 2019), the 2014-2018 Current Population Survey (CPS; Flood et al. 2018), the 2015-2016 National Postsecondary Student Aid Survey (NPSAS; U.S. Department of Education, National Center for Education Statistics 2018), the

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[1] Fact sheets for each state can be found on IWPR's website: http://iwpr.org/tools-data/investing-in-single-moms-by-state/. The national briefing paper can be found here: https://iwpr.org/publications/investing-in-single-mothers-higher-education-national-state-costs-benefits/.

2003-2009 Beginning Postsecondary Student Survey (BPS; U.S. Department of Education, National Center for Education Statistics 2011), the Integrated Postsecondary Education Data System (IPEDS) 2015 fall enrollment component (U.S. Department of Education, National Center for Education Statistics 2017), and other federal data sources.

Estimating the Number of Single Mother Students by State

Because no state-level data are available on single mother enrollment in college, IWPR relied on data from the IPEDS, NPSAS, and BPS to estimate the number of single mothers currently enrolled in each state as well as how many are expected to graduate with associate or bachelor's degrees. To do this, we first multiplied state-level enrollment numbers from IPEDS by regional shares of students who are mothers and shares of mothers who are single (defined as single, never married; widowed; separated; or divorced) from the NPSAS to estimate the total enrollment of single mothers in each state. To be consistent with the regional data from the NPSAS, which is for the 2015-16 academic year, we used fall 2015 enrollment data from IPEDS.

Next, to estimate the number of single mothers in each state that are expected to graduate with associate or bachelor's degrees, we multiplied the state-level estimates of single mother enrollment by the national six-year attainment rate among single mothers of bachelor's degrees (1.8 percent), associate degrees (6.8 percent), and some college education, no degree (which includes single mothers who dropped out with no degree, are still enrolled without a degree, and who earned certificates; 91.8 percent) from the BPS. Attainment rates by region were not available due to small sample sizes.

Of course, some of the single mothers in the some college, no degree category may eventually graduate (just not in six years), however, we have limited data to show what ultimately happens to single mothers in this group. This means that we are likely overestimating the number of single mothers with some college, but no degree. And, as a result, we are likely underestimating the overall benefits that the cohort of single mothers currently enrolled in college will produce as a result of their education.

Establishing a Baseline for Comparison

The fundamental question of IWPR's analysis is "How are the outcomes for single mothers who earn degrees or some college education different from what they would experience had they not attended college?" To answer this question, we first estimated our outcomes of interest—lifetime earnings, lifetime public assistance receipt, and lifetime tax contributions—for a baseline group of single mothers with a high school diploma only.

Lifetime Earnings

To estimate lifetime earnings for the baseline group, IWPR combined three years of ACS data (2015, 2016, and 2017) accessed through the Integrated Public Use Microdata Series (IPUMS) in order to ensure adequate sample sizes. Dollar values in the combined data file were adjusted to their 2017 equivalents using the Consumer Price Index for All Urban Consumers. In addition, IWPR took the average of the sample weights across the three years of data to represent the average population during the three-year period. We used these adjusted weights in our analysis to obtain representative statistics for our population of interest.

Using the ACS, we first constructed a synthetic age-employment trajectory for single mothers aged 35 to 64 with only a high school education. We chose 35 as the starting age because we wanted to ensure that most single mothers had completed their college education prior to our estimation. Based on available estimates from the BPS, most single mothers complete their college education in their early 30's. The age of 64 was chosen for the end of the range as an approximation for the age of retirement.

The age-employment trajectory is constructed by estimating average rates of employment among single mother high school graduates by Census Division at different age intervals: 35-39, 40-44, 45-49, etc. Given that we are unable to observe adult children in the ACS unless they are living at home with their parents, we estimate average employment rates among all single women regardless of parental status for the age groups 55-59 and 60-64, as most women's children will have become adults by this age.

Next, we construct an age-earnings trajectory for single mother high school graduates aged 35-64 by Census Division. Like the age-employment trajectory, we estimate median annual earnings among single mothers who are employed (regardless of full-time/part-time status) at each age interval. As with the age-employment trajectories, we estimate median annual earnings among all single women regardless of parental status for women aged 55 and older.

To account for the fact that not all single mothers are working in a given year, we combine these two trajectories to estimate an *expected* lifetime earnings trajectory for single mothers with a high school education. This is done by multiplying the average employment rate for single mothers at each age by the median annual earnings among single mothers who are working. The sum of expected earnings at each age then provides our estimate of expected lifetime earnings for our baseline group.

Lifetime Public Assistance Receipt

To estimate lifetime public assistance receipt for the baseline group, IWPR utilized data from the CPS Annual Social and Economic Supplement (ASEC) accessed through IPUMS. The ASEC has smaller sample sizes than the ACS, however, it contains more detailed information on sources of income for

respondents, allowing us to examine income from various types of public assistance. IWPR combined five years of data (2014-2018) from the ASEC in order to ensure adequate sample sizes. As with the lifetime earnings analysis in the ACS data, dollar values in the combined ASEC data file were adjusted to their 2017 equivalents, and the average of the sample weights across the five years of data was taken and used throughout the analysis to represent the characteristics of the average population during the five-year period.

For this analysis, IWPR focused on three different sources of public assistance. The first is what is commonly known as "welfare" and includes any income from Temporary Assistance for Needy Families (TANF), the General Assistance Program, Emergency Assistance, and Cuban/Haitian Refugee and Indian Assistance. The second includes the cash value of benefits from the Supplemental Nutrition Assistance Program (SNAP), or "food stamps." The third is the value of housing assistance, including whether the respondent's housing is owned by a local housing authority or other public agency, whether they are paying lower rent because the federal, state, or local government is paying part of the cost, and whether they receive assistance from Section 8 or any other government program.

Similar to the lifetime earnings analysis, we first constructed a synthetic age-receipt trajectory for each of the three types of assistance among single mothers aged 35-64 with only a high school education. This measures how single mothers' likelihood of receiving any of the three types of public assistance changes over their lifetime. For the age groups 55-59 and 60-64, we estimated the likelihood of receiving public assistance among all single women regardless of parental status. All three trajectories are estimated at the Census Division level where sample sizes permit. If sample sizes are insufficient for a specific division, it is replaced with data from the corresponding Census Region, a slightly more aggregated geographic area.

Because estimating the average amount of assistance received among single mothers requires an analysis of only those receiving any assistance in a given year, which tends to be a small share, sample sizes do not allow us to construct trajectories of the amount of assistance received by age. Instead, we estimate the average amount of assistance received by all single mothers with a high school education receiving any assistance by Census Region for each of the three types of public assistance. This requires an assumption that the average amount received will not change significantly among single mothers (when they do receive benefits) by age.

Finally, to account for the fact that not all single mothers will receive public assistance in a given year, we combine the receipt and amount trajectories for each type of public assistance to estimate *expected* lifetime public assistance trajectories for single mothers with a high school education. This is done by multiplying the average likelihood of receipt for single mothers at each age by the median annual amount received among single mothers who do receive assistance. The sum of expected assistance at each age then provides our estimate of expected lifetime assistance from each of the three sources for our

baseline group. The sum across the three different types of assistance gives us the total expected lifetime public assistance receipt, which is used later in our return on investment calculations.

It should be noted that there are limitations to using survey data from the ASEC to estimate single mothers' receipt of public assistance benefits. Research has documented that rates of receipt and amount of receipt reported in household surveys, like the ASEC, tend to be under-reported, meaning that estimates based on such surveys underestimate the share of households receiving public assistance benefits as well as the amount of assistance received (Meyer, Mok, and Sullivan 2009). However, the absence of publicly available administrative data at the state level on public assistance receipt among single mothers by education level necessitates the use of survey data. The implication of this data limitation is that IWPR's estimates of single mothers' lifetime public assistance receipt will be underestimated and, as a result, our estimates of the return on investment (discussed below) will be underestimated as well.

Lifetime Tax Contributions

Because all earnings values in our analysis are in 2017 dollars, we utilize the parameters of the 2017 federal and state tax systems. This, of course, requires us to assume that the federal and state tax systems will be largely unchanged in the future, though this has not been the case.[2] To the extent that any changes to the tax system impact single mothers at different levels of education in a similar way, however, the overall differences in tax contributions between single mothers with a high school education and those with a college education may be largely unchanged.

Using the estimated lifetime earnings trajectory of single mothers with a high school education, we separately estimate the amount of taxes that single mothers will pay each year between the ages of 35 and 64. Tax filing status, dependent exemptions, and eligibility for various tax credits depend on the number and age of dependent children in the household. To account for this, IWPR estimated the average number of children that single mothers had at age 35 (the starting year of our lifetime earnings analysis) as well as their average ages using the ACS. On average, single mothers have two children, ages 5 and 9, at this age. For each subsequent year, we added on an additional year to the age of the two children, and reduced the number of dependent children single mothers claimed when each child turned 19.

We assume that single mothers will file as "Head of Household" while they still have dependent children, and as "Single" when their children are grown. For simplicity, we also assume that single

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[2] For example, the Tax Cuts and Jobs Act of 2017 made substantial changes to individual income tax rates, the Child Tax Credit, and personal and dependent exemptions and went into effect in 2018. It is unclear the extent to which these changes will affect overall tax contributions among single mothers and the differences between the tax contributions of single mothers at different levels of education. However, these changes are scheduled to sunset in 2025, meaning that they will not be permanent (Tax Policy Center 2018).

mothers will not itemize deductions. Further, we assume that single mothers will not marry at any point, which would affect their tax filing status and household income, though this of course may not be the case. We make this assumption for simplicity, as the complex dynamics of the situation make it unclear how the possibility of marriage will affect single mothers' tax contributions.

At each age, we use the standard deduction, personal exemption, and dependent exemptions from the 2017 federal tax system for the appropriate filing status and number of dependent children to estimate the amount of federal income tax paid. This is done by subtracting all deductions and exemptions from single mothers' estimated earnings, giving us their taxable income. This taxable income is then compared with the federal income tax brackets and the appropriate tax rate(s) are applied to estimate total federal tax paid. To estimate the amount of state income taxes paid by single mothers, IWPR relied on a tax calculator, which uses filing status, number of children, and annual income at each age to estimate the total state income tax paid each year (Tax Form Calculator 2019).

In addition to federal and income taxes, single mothers will also pay Federal Insurance Contributions Act (FICA) taxes. As of 2017, the FICA tax rate was 7.65 percent for employees, and is applied to total income (not taxable income; Miller 2016). IWPR estimated the total FICA taxes paid per year by single mothers in each state by multiplying the FICA tax rate by their estimated total earnings at each age.

Single mothers also pay taxes through their spending on taxable goods. Data from the Pew Charitable Trusts indicates that the typical family of four spends about 29 percent of their income on non-housing expenditures including food, transportation, health, entertainment, and apparel (Pew Charitable Trusts 2016). Further, data from California indicate that taxable sales as a fraction of personal income was about 28 percent in 2018 (Newsom 2019). Based on this information, we assume that single mothers will spend about 30 percent of their income on taxable goods. By multiplying total income at each age by 30 percent, we are able to estimate single mothers' total taxable expenditures. These state-level estimates of taxable expenditures are then multiplied by their corresponding state and local sales tax rates (combined for a weighted average sales tax rate) to estimate the total amount that single mothers pay in sales tax each year (Walczak and Drenkard 2017).

Finally, single mothers are likely to qualify for a number of tax credits that can reduce their tax burden. Two of the most common tax credits are the Earned Income Tax Credit (EITC) and the Child Tax Credit (CTC). Eligibility for these credits depends on family income as well as the age and number of dependent children. IWPR utilized two tax calculators to evaluate the amount of each credit that single mothers would be eligible for, if they claimed the credits (Tax Form Calculator 2019; Bankrate 2019). The values of each of these two credits were then multiplied by the probability that a single mother would claim each credit to adjust for the fact that not all single mothers who are eligible for the credits will claim them. According to the Tax Policy Center, the share of households with dependent children

that received the CTC varied from 75 percent to nearly 100 percent by household income level. For simplicity, IWPR assumed that 80 percent of single mothers would claim and receive the credit. Research by Bhargava and Manoli (2015) estimates that about 75 percent of eligible tax filers claim EITC benefits.

Finally, IWPR estimated the total amount of taxes paid by single mothers in each state by adding together our estimates of federal and state income taxes as well as sales taxes and then subtracting the expected value of both tax credits.

The Benefits and Costs of Pursuing College Education among Single Mothers

Once we estimated the lifetime earnings, public assistance receipt, and tax contributions among single mothers at baseline, we turned our attention to examining how these outcomes are expected to improve when single mothers pursue a college education and whether the benefits outweigh the costs on average.

The Effect of College Education on Single Mothers' Lifetime Earnings

A substantial body of research exists documenting the relationship between education and earnings, finding that people tend to earn more when they have higher levels of educational attainment (for a review of the literature see Card 1999). Extensions of this research have estimated these relationships for different groups of people, focusing mostly on differences by gender and by race/ethnicity. However, to date there is no study that specifically examines the impact of college education for single mothers by state—the focus of this analysis.

We adapt our estimation strategy for this specific population of interest from the existing literature, which estimates models of employment and earnings as a function of worker demographic and socioeconomic characteristics as well as their educational attainment. This estimation strategy is different from more descriptive analyses, which rely on differences in outcomes of interest by level of education to illustrate the benefits of higher education.

IWPR's analysis controls for different demographic and socioeconomic characteristics that could influence both single mothers' likelihood of pursuing higher education as well as their earnings potential (and other outcomes of interest). This analysis allows us to estimate the effect of education, net of all other characteristics. This is an important distinction, because it is likely that single mothers who pursue college degrees are also more likely to earn more, regardless of if they attend college (economists typically say that they have "higher levels of innate ability" than single mothers who do not enroll in college). As a result, descriptive analyses that compare outcomes by educational attainment tend to overestimate the impact of college on economic outcomes, which is why our method is preferred.

For the models of employment, we utilize the ACS data and run linear probability models for each state, which estimate the probability of employment as a function of age (and its square), race/ethnicity, foreign-born status, disability status, urban residence, number of children in the household, whether there are any children under the age of six in the household, and educational attainment. Education is included in six categories—less than high school, high school graduate, some college education, associate degree, bachelor's degree, and postgraduate education—with high school graduates serving as the comparison group. The coefficients on the some college, associate degree, and bachelor's degree indicators tell us how much those levels of educational attainment change the probability of employment relative to similar individuals with a high school diploma only (our comparison group). These models are run only for single mothers aged 25 and older. Each model is estimated at the state level, where sample sizes permit. If sample sizes are insufficient for a specific state, the results are replaced with data from the appropriate Census Division.

We run similar models of annual earnings for employed single mothers at the state level. Using the ACS, linear regression models of annual earnings are run as a function of age (and its square), race/ethnicity, foreign-born status, disability status, urban residence, number of children in the household, whether there are any children under the age of six in the household, sector of employment, usual hours of work per week, number of weeks worked per year, and educational attainment. The coefficients on the some college, associate degree, and bachelor's degree indicators tell us how much those levels of educational attainment change the earnings of single mothers relative to similar individuals with a high school diploma only. These models are run only for single mothers aged 25 and older, who are currently employed and have non-zero earnings. As with the employment models, each model is estimated at the state level where sample sizes permit. Where sample sizes are insufficient, the results are replaced with data from the appropriate Census Division.

IWPR then used the model results to adjust the baseline age-employment and age-earnings trajectories for the effects of education on employment and earnings. This is done by simply adding the relevant education coefficient from the employment/earnings model to the baseline trajectories across all ages. This requires a simplifying assumption that the impact of education on employment and earnings is relatively constant over a single mother's working life. This does not mean that single mothers' likelihood of working or their earnings are constant, but rather that differences in their likelihood of working and their earnings relative to a single mother with a high school diploma do not significantly change over their working life. IWPR separately verified that the unadjusted differences in employment and earnings for single mothers by educational attainment remain relatively stable across age groups.

Finally, these adjusted age-employment and age-earnings trajectories for single mothers with a college education are used to estimate lifetime earnings for single mothers with some college, associate degrees,

and bachelor's degrees. As with our baseline calculations above, we combine the two trajectories (by education level) to estimate an *expected* lifetime earnings trajectory for single mothers with each level of college education. This is done by multiplying the adjusted average employment rate for single mothers at each age by the adjusted median annual earnings among single mothers who are working. The sum of expected earnings at each age then provides our estimate of expected lifetime earnings for each level of college education. These lifetime expected earnings can be compared with the expected lifetime earnings of the baseline group to estimate the total impact of different levels of college education on single mothers' lifetime earnings.

The Effect of College Education on Single Mothers' Lifetime Public Assistance Receipt

Using the CPS ASEC data, and following a similar methodology as in the estimation of the impact of education on lifetime earnings, IWPR estimated models of the likelihood of receiving each of the three types of public assistance ("welfare," SNAP, and housing assistance) as well as the amount received (among those receiving any) as a function of single mothers' demographic and socioeconomic characteristics as well as their educational attainment.

Specifically, IWPR estimated linear probability models of the likelihood of receipt and regression models on the amount received (among those receiving any assistance) among single mothers as a function of age (and its square), race/ethnicity, foreign-born status, urban residence, number of children in the household, whether there are children under the age of six in the household, labor force participation status, and educational attainment. The coefficients on the some college, associate degree, and bachelor's degree indicators tell us how much each level of education changes the probability of receiving each type of public assistance as well as the amount received. As with the employment and earnings models, the public assistance models are limited to single mothers aged 25 and older. Due to sample size limitations, however, IWPR was only able to estimate these models at the national level.

IWPR used the model results to adjust the baseline age-receipt and age-amount of receipt trajectories for the effects of education on the likelihood of receiving assistance and the amount received. To do this, we added the relevant education coefficient from the receipt/amount model to the baseline trajectories across all ages. This also requires the simplifying assumption that the impact of education on the likelihood of public assistance receipt and the amount received is relatively constant over a single mother's working life. Again, this does not mean that single mothers' likelihood of receiving assistance or that the amount received are constant, but rather that differences in their likelihood of receiving assistance and how much they receive relative to a single mother with a high school diploma do not significantly change over their working life.

Finally, these adjusted age-receipt and age-amount of receipt trajectories for single mothers with a college education are used to estimate lifetime public assistance received among single mothers with some college education, associate degrees, and bachelor's degrees. We first combine the age-receipt and age-amount of receipt trajectories (by education level) for each type of public assistance separately, to estimate an *expected* lifetime assistance trajectory for single mothers with each level of college education. These separate expected lifetime assistance trajectories are then added together to create a total expected lifetime public assistance trajectory that includes assistance from all three sources. Comparing these expected lifetime public assistance trajectories with the estimated baseline trajectory illustrates the expected impact of different levels of college education on lifetime public assistance receipt.[3]

The Effect of College Education on Single Mothers' Lifetime Tax Contributions

In order to evaluate the impact of college education on single mothers' lifetime tax contributions, IWPR followed the same methodology for estimating lifetime tax contributions by educational attainment as it did for the baseline group (discussed in detail above). Each education level's adjusted lifetime expected earnings trajectory was run through the 2017 federal and state tax systems to estimate the total lifetime taxes paid by education level, net of any credits received. These lifetime tax contributions were then compared with the lifetime tax contributions of single mothers with a high school diploma to estimate the increase in tax contributions resulting from the attainment of various levels of college education.

The Cost of College for Single Mothers

To calculate the total cost of college attendance, IWPR relied primarily on regional data from the NPSAS, supplemented with additional information from the BPS, ACS, and published research reports. The primary cost of attendance that IWPR calculated is the cost of tuition and any relevant course materials or supplies. In addition, we also estimate the opportunity cost of attendance. This assumes that single mothers attending school may reduce their work hours or leave the workforce entirely in order to attend classes, which, in turn, can reduce her earnings while in school. Further, we take into account the fact that many single mothers also incur child care costs associated with attending classes.

Tuition and Supplies

IWPR estimated the average amount of tuition paid per year as well as the average cost of required course materials per year among single mothers by region and by institution type (two-year or public and private four-year) using data from the NPSAS. These estimates of the average cost of tuition and

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[3] As with the baseline estimate of single mothers' lifetime public assistance receipt, IWPR's estimates of the impact of college education on single mothers' lifetime public assistance receipt will be underestimated due to the under-reporting of public benefits in household surveys like the ASEC.

course materials account for the fact that many single mothers only attend college on a part-time basis. Because of this, they are much smaller than most published cost of college data, as those data typically assume full-time enrollment status. To estimate the total cost of each level of college education, IWPR estimated the total number of years enrolled by dividing the number of months enrolled to degree or to stop-out at the national level from the BPS by the regional average number of months enrolled per year from the NPSAS. Estimated years of enrollment were then multiplied by annual tuition and course materials costs to calculate the total amount that single mothers are expected to spend on tuition and course materials for each level of education.

Opportunity Cost

To estimate the opportunity cost of attending college, we need estimates of the number of hours worked and annual earnings among single mothers while they were attending college as well as while they were not enrolled. Because it is impossible to know how many hours a single student mother would have worked and how much she would have earned if she were not enrolled in college, IWPR approximated these differences in hours and earnings using two separate data sources. To estimate earnings while enrolled, IWPR used data from the NPSAS at the regional level and included single mothers who were not working in the calculation of the average.

To estimate hours worked while enrolled/not enrolled in college, IWPR utilized the ACS at the Census Division level, which has an indicator for whether an individual is currently enrolled in school. We estimated the average hours worked per week among single mothers who were enrolled/not enrolled in school by level of educational attainment. Average hours worked per week among single mothers currently enrolled in school with some college education, but no degree, was used to approximate average hours worked per week while in school. Average hours worked per week among single mothers not enrolled with either a high school diploma or some college education was used to approximate average hours worked per week while not in school. Both estimates of average hours worked included single mothers who were not working. IWPR used the ACS data for both estimates, rather than using the NPSAS to estimate the average hours worked while enrolled, for the purpose of consistency and to ensure that differences between the two data sources did not influence the overall estimated difference in the number of hours worked by enrollment status.

Using these two pieces of information, IWPR constructed an adjustment factor for single mothers' earnings using the hours worked data. Specifically, we calculated the percentage change in hours worked when single mothers are not enrolled relative to when they are enrolled and then increased single mothers' earnings while enrolled in college by this amount. This provides an estimate of their earnings while not enrolled in college—e.g. if they worked 10 percent more hours while not enrolled, we estimate that earnings while not enrolled will be 10 percent higher than they are while enrolled.

Finally, the difference between single mothers' estimated annual earnings while not enrolled and their earnings while in school provides an estimate of the annual opportunity cost of single mothers' college attendance. This annual estimate of opportunity cost was then multiplied by the estimated number of years enrolled (described above) to calculate the total opportunity cost that single mothers are expected to incur at each level of education.

Child Care

Single mothers are also likely to utilize child care services while they are attending classes, office hours, study groups, or engaging in any other school-related activities. IWPR estimated the share of single mothers with children in paid child care and the average amount spent per month on child care, among those using paid child care, using regional data from the NPSAS. These costs may include non-school-related child care costs, however, including child care costs incurred while at work.

To estimate the share of these costs that are school-related, IWPR estimated the number of hours that single mothers were likely to spend in class, commuting, and attending office hours or study groups per week. Using regional data from the NPSAS on single mother enrollment intensity (exclusively full-time, exclusively part-time, and mixed full/part-time), we assumed that single mothers attending part-time would enroll in two classes per semester (two semesters per academic year), those attending full-time would enroll in four classes per semester, and those attending mixed full/part-time would enroll in two classes for one semester and four in another. We also assumed that each class would meet twice a week for an hour and 15 minutes. This information allowed us to estimate the number of hours per week that single mothers spend attending classes.

Research from Fosnacht, McCormick, and Lerma (2018) was used to approximate the amount of time that single mothers spend commuting to and from classes. Using a randomly selected subsample of first-year students from the National Survey of Student Engagement (surveyed in 2014 or 2015), they examine the time use patterns of different groups of students. While they do not look at single mothers specifically, they do find that parents spend the most amount of time commuting per week at 3.9 hours. We assume, for simplicity, that the amount of time spent commuting among single mothers will be approximately the same as with all parents.

Commute times were then added to time spent in class and an additional hour per week was added to account for other random and unscheduled school-related activities such as attending office hours or study groups. Single mothers may not spend any time on these activities in a given week, or they may spend far more than one hour in another week, particularly around exam times. We think that on the whole, these differences will average out over a semester.

Finally, IWPR estimated the total number of hours that single mothers spend in class <u>or</u> at work per week by adding the estimated work hours while enrolled (described above) to the estimated hours spent on school-related activities. The share of total hours that are school-related was then calculated and multiplied by the average monthly cost of child care from the NPSAS to estimate the amount spent on child care while attending class. To get an estimate of the average amount spent per year, IWPR multiplied the monthly cost by the regional average number of months enrolled per year from the NPSAS and then by the regional share of single mothers with children in paid child care. This annual estimate of child care costs was then multiplied by the estimated number of years enrolled (described above) to calculate the total child care cost that single mothers are expected to incur at each level of education.

Other Non-Tuition Costs

In addition to the costs that single mothers incur as a direct result of enrolling in college, they must also provide for their family's basic needs, such as housing, food, transportation, and child care for the time that they spend working (on top of going to school). These costs add up and the financial stress can have a negative impact single mothers' ability to persist in school.

To get a better idea of the "full" costs that single mothers incur while attending college, IWPR examined the estimated student budget (reported by the institution) by region among single mothers in the NPSAS. In addition to tuition and fees, this includes books and supplies, room and board, transportation, and other personal expenses. The results highlight just how much these additional costs can contribute to the overall financial burden of attending college for single mothers.

Nationally, single mothers are expected to spend just over $14,000 pursuing an associate degree, but when these additional costs are taken into account, they are expected to spend just over $47,000. For single mothers pursuing a bachelor's degree, they are expected to spend nearly $57,000, but will spend nearly $116,000 when these additional costs are factored in.

For the purposes of the cost-benefit analysis, however, IWPR only included the "new" costs that single mothers incur as a result of pursing a college education—tuition and fees, books and supplies, the opportunity cost of reduced earnings from work, and child care costs while attending class. These correspond to the lower cost estimates described above.

Adjusting Regional Cost Data to State Levels

As indicated above, most of the data that IWPR utilized in the analysis of the costs associated with pursuing a college degree for single mothers was regional data from the NPSAS and ACS. The NPSAS is not representative at the state level and sample size limitations would not allow for a state-level analysis in the ACS.

IWPR adjusted the regional cost estimates for state-level variation in cost of living and average tuition rates to get unique state-level costs of attendance. We did this in two parts. The first part dealt with state-level variations in average tuition rates. IWPR pulled data on average tuition and fees by institution type and by state from IPEDS. For simplicity, we only examined in-state tuition rates. We combined this with our previously-calculated estimates of single mother enrollment by state and by institution type (from IPEDS and NPSAS) to calculate a weighted average tuition rate for each region by institution type and overall. Each state's average tuition rate was then divided by the regional average tuition rate to create an adjustment factor that was then applied to the regional tuition and course materials costs estimated in the NPSAS.

For associate degrees we applied an adjustment factor based on average tuition at public two-year colleges. For bachelor's degrees we applied an adjustment factor based on a weighted average of public and private four-year colleges. And for the some college, no degree group, we used an adjustment factor based on the overall weighted average of all institution types, as this group could be attending any type of institution.

For regions with states who were missing data on public two-year colleges, we calculated a weighted regional average based on the states that did have data available. There was only one state that was missing data on private four-year college tuition rates—Wyoming. As Wyoming does not have any private four-year colleges, we used only the public four-year data in computing the average across public and private colleges for that state.

To adjust the opportunity cost and child care cost data to the state level, IWPR created a cost of living adjustment factor. The cost of living index by state was obtained from World Population Review (2019). As with the tuition adjustment, IWPR estimated a weighted average of the cost of living index in each region (weighted by the number of single mothers enrolled in each state in the region). Each state's cost of living index was then divided by the regional average to calculate its cost of living adjustment factor, which was then applied to the regional opportunity cost and child care costs estimated in the NPSAS.

Finally, as the NPSAS data are from the 2015-2016 academic year and their costs are in 2015 dollars, we adjusted all of the estimated costs to 2017 dollars to be consistent with the benefits calculations described above. We did this by creating an adjustment factor using the Current Price Index (CPI) for the years 2015 and 2017 from the Bureau of Labor Statistic, dividing the 2017 CPI by the 2015 value (U.S. Bureau of Labor Statistics 2019). The adjustment factor was then multiplied by the adjusted state-level costs of attendance to arrive at our final state-level cost estimates.

Aggregate Estimates of the Impact of Single Mothers' College Education

In order to estimate the aggregate benefits and costs of college education for the cohort of single mothers currently enrolled in each state, we combined the estimated number of single mothers enrolled by state as of 2015-2016 with information on average on-time graduation rates for single mothers from the BPS to determine approximately how many of the currently enrolled single mothers will receive an associate's degree, bachelor's degree, or who will not receive a degree within six years. The number of single mothers from each of these groups was then multiplied by the estimated individual benefits and costs, described above, to arrive at the estimated total benefits and costs for the cohort of single mothers currently enrolled in college.

The Return on Investment in College for Single Mothers

While there are clearly other benefits that single mothers receive from pursuing a college education—intrinsic satisfaction, the ability to pursue a more fulfilling career, improved health outcomes, benefits to children, etc.—many of these benefits are difficult to quantify. Thus, for the purposes of the return on investment analysis for individual single mothers, IWPR focused only on the increase in lifetime earnings that single mothers are expected to see as a result of their educational investments. While IWPR did estimate the impact of single mothers' college education on public assistance spending and tax contributions, these represent public benefits, not individual benefits, and therefore were only considered when evaluating public investments in supportive services to improve single mothers' college outcomes.

To estimate single mothers' individual return on investment in their education, IWPR first discounted the expected lifetime earnings streams that they would receive at each level of education to their present value. Following Levin et al. (2006), we use a discount rate of 3.5 percent. Similarly, IWPR discounted the stream of annual costs that single mothers are expected to incur for the duration of their time enrolled to their present value.

IWPR then took the difference between single mothers' discounted lifetime earnings at each level of college education and their discounted lifetime earnings with just a high school education. These earnings gains were divided by the discounted total cost of the relevant level of educational attainment to produce the rate of return for each level of education.

Investments in Supportive Services to Improve Single Mothers' College Outcomes

IWPR also set out to understand how investing in supportive services might pay off for single mothers and for society in the long run. The present study focuses on three supports that have shown evidence of

improving single mother college completion: child care, targeted financial aid, and case management services.

As an illustrative example, IWPR evaluated the economic benefits and costs of providing each of these three supports to the cohort of single mothers currently enrolled in college. While this exercise only provides a snapshot of the costs and benefits associated with these interventions, the findings of the return on investment analysis are widely applicable to other contexts and investment levels.

Impact on Graduation Rates

IWPR first reviewed the published literature evaluating the impact of these investments on student graduation rates. This information was used to adjust current graduation rates among single mothers and estimate the hypothetical number of single mothers who would graduate with associate or bachelor's degrees as a result of each of the three interventions.

Child Care

While data on the impact of child care on single mothers' graduation rates is limited, analysis of eight years (2006-2014) of data from Monroe Community College (MCC) in Rochester, NY, which tracks student parents' outcomes and campus child care usage, and anonymous student-level attainment data from the National Student Clearinghouse, finds that, for students who were enrolled at least three terms between 2006 and 2012, those who used the campus child care center were 21 percent more likely to earn a degree at any point through summer 2018 (rather than within the three-year definition of "on time" completion for associate degrees) than their counterparts with children who did not use the center (Miller 2019).

According to IWPR's analysis of national data from the BPS, approximately 6.4 percent of single mothers currently enrolled are expected to graduate with an associate degree and 1.8 percent with a bachelor's degree. These graduation rates were increased by 21 percent to 7.7 percent and 2.2 percent respectively. The adjusted graduation rates were then applied to each state's estimated enrollment of single mothers to estimate the number of single mothers that would graduate with associate and bachelor's degrees if child care was provided to all single mother students.

Financial Aid

Financial aid is also associated with improved degree completion, particularly for students with low incomes (Castleman and Long 2013; Franke 2014; Goldrick-Rab et al. 2016). One study evaluated of the impact of financial assistance on degree attainment for over 6,500 students from 651 four-year colleges and universities in the United States. The study found that for every $1,000 dollar increase in aid received though federal grants, students are 1.6-2.8 percent more likely to graduate (Franke 2014).

IWPR utilized the 2.8 percent increase per $1,000 investment figure in its calculations and assumed a $2,000 per year investment in single mother students—a 5.6 percent increase per year.[4] This, coupled with information on the average number of years that single mothers are enrolled before completing an associate or bachelor's degree gave us an estimated 25.5 percent increase in single mothers graduating with associate degrees and an estimated 34.4 percent increase in single mothers graduating with bachelor's degrees. The adjusted graduation rates were then applied to each state's estimated enrollment of single mothers to estimate the number of single mothers that would graduate with associate and bachelor's degrees if additional financial aid was provided to all single mother students.

Case Management

Evidence suggests that intensive case management can improve outcomes for students who have comparable backgrounds to student parents (Bettinger and Baker 2014; DVP-PRAXIS 2019; Evans et al. 2017; Scrivener et al. 2015). In one randomized control trial, researchers measured the impact of comprehensive case management (which included mentoring, coaching, and referrals to services, in addition to limited access to emergency financial assistance) on 1,168 community college students' outcomes at Tarrant County College in Fort Worth, Texas between 2013 and 2016. They found that for women, case management tripled associate degree receipt. For all students, the intervention was associated with a 47.1 percent increase in degree completion (Evans et al. 2017).

IWPR utilized the 47.1 percent increase figure to adjust single mothers' graduation rates. This resulted in an increase in the share of single mothers graduating with associate and bachelor's degrees to 9.4 percent and 2.6 percent respectively. The adjusted graduation rates were then applied to each state's estimated enrollment of single mothers to estimate the number of single mothers that would graduate with associate and bachelor's degrees if comprehensive case management services were provided to all single mother students.

Reductions in Public Assistance Spending and Increases in Tax Contributions

In order to evaluate the overall societal benefit to each investment in supportive services for single mother students, IWPR first calculated the aggregate reductions in public assistance spending and increases in tax contributions resulting from their increased educational attainment among the current cohort of single mothers enrolled in college (in the absence of the supportive service). As discussed above, we multiplied the number of currently enrolled single mothers in each state who are expected to graduate with associate and bachelor's degrees with the estimated decrease in lifetime public assistance

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[4] IWPR utilized the upper bound of the impact found in Franke (2014) because, while it was the upper bound of Franke's estimates, it represented a more conservative estimate based on the range of other estimates found in the literature, which ranged from about 1.6 percent to 8 percent.

receipt as well as the estimated increase in lifetime tax contributions. The number of single mothers not expected to graduate was also multiplied by the corresponding estimates for the some college, no degree population. These aggregate benefits were added up over all currently enrolled single mothers in each state.

Next, IWPR estimated the aggregate reductions in public assistance spending and increases in tax contributions that would result from each of the three investments in supportive services. This was done exactly as it was above, but with the adjusted graduation rates under each investment taken into account, increasing the number of single mothers graduating with associate and bachelor's degrees while also decreasing the number of single mothers stopping out, resulting in an increase in the overall societal benefit.

Finally, the aggregate benefit with no supportive service investment is subtracted from the aggregate benefit under each of the three investments to arrive at the estimated increase in social benefits as a result of the investment.

Investment Cost

IWPR estimated how much it would cost to invest in each of these supports for all currently enrolled single mothers nationally and by state, including those who are not expected to graduate, using published cost information. For each of the costs outlined below, IWPR multiplied the total cost per student at each educational attainment level (some college, no degree; associate degree; bachelor's degree) by the total number of students expected to graduate with an associate or bachelor's degree or to stop out in each state, adjusted for the expected increase in graduation rates as a result of each intervention. This provides an estimate of the total investment cost required if applied uniformly to all currently enrolled single mothers.

Child Care

IWPR utilized data from a variety of sources to estimate the total investment required to provide child care for all currently enrolled single mothers. We first calculated the median cost of child care for children ages 0-4 by state using data from Child Care Aware of America (2018), and then prorated it by the estimated number of single mother students with children under 6 who need full-time or part-time care using data from the NPSAS.

To estimate single mother students' child care needs, IWPR first calculated the estimated number of single mothers nationally and by state with youngest children ages 0-5 by multiplying previously estimated numbers of total single mother enrollment nationally and by state (explained above) by regional data on age of youngest child from the NPSAS. We then calculated the number of single

mothers with children ages 0-6 that are enrolled full-time, part-time, and a mix of full- and part-time, using regional data from the NPSAS on enrollment intensity applied to state-level estimates of single mother students by age of children. For simplicity, IWPR made conservative, general assumptions about single mothers' care needs while in college: it assumed that full-time-enrolled single mothers with children under age six need full-time care and part-time-enrolled single mothers with children under age six need part-time care. Single mothers enrolled for a mix of part- and full-time were counted as full-time students for the purposes of their child care needs. Part-time care is defined as half-time for simplicity.

The number of part- and full-time child care slots needed was then calculated by multiplying the number of full- and part-time-enrolled single mothers with children 0-5 by the average number of children in those age groups among single mother students from regional NPSAS data, with the number of single mothers assumed to need part-time care multiplied by half. The number of part- and full-time slots needed for children under six were then added to arrive at the total estimated slots needed. Finally, the median annual cost of child care from Child Care Aware (2018) for the United States and each state was calculated across age groups (ages 0-4) and prorated by the share of total slots needed by part- and full-time care needs.

Next, we multiplied this prorated annual cost by the share of total care hours needed that would be for school-related activities. As described above, this takes the weekly hours spent in class, commuting, and attending office hours or study groups as a share of the total hours spent working or going to school using data from the ACS, NPSAS, and from Fosnacht, McCormick, and Lerma (2018). We estimate that approximately 27 percent of single mothers' total hours of child care potentially needed are for the time they spend on school-related activities. This results in an approximate annual cost of $2,300 per student. The total investment cost per student depends on how long they remain enrolled before graduating or stopping out, but IWPR estimates that on average this investment will cost between $8,000 and $14,000 per student.

Financial Aid

Following Franke (2014), who found that for each additional $1,000 in financial aid received though federal grants students are 1.6-2.8 percent more likely to graduate, IWPR chose an investment level of $2,000 per year. This investment level was very similar to the required annual investment level for each of the other two investments, and produced a sizable increase in graduation rates among single mothers. IWPR estimates that on average this investment will cost between $7,000 and $12,000 per student.

Case Management

IWPR utilized case management cost estimates from Evans et al. (2017), who evaluated the costs and impact of a heavy-touch case management program called Stay the Course. They estimate that the total cost per student is approximately $1,880 per year and assumes that each case manager has a case load of 34 students. IWPR estimates that on average this investment will cost between $6,500 and $11,500 per student.

Return on Investment

To evaluate the return on investment in each of the three supportive services discussed above, we discounted the stream of total increases in social benefits at the state level (decreased public assistance spending and increased tax contributions) as well as the total investment cost per state to their present values using a discount rate of 3.5 percent. The discounted total increase in social benefit was then divided by the discounted total investment cost to estimate the rate of return for each investment.

The return on investment that is estimated for each of these supports assumes that the investment will be made in all single mothers attending college, even the ones that will not graduate. There is an extensive literature, however, documenting the value of some college education relative to a high school diploma only, and we include these benefits for the group of single mothers who are not expected to graduate in our overall return on investment calculation.

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