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ABSTRACT

This study seeks to determine the role that parental incarceration plays on the probability of food insecurity among families with children and very low food security of children using micro-level data from the Fragile Families and Child Well Being Study (FFCWS). The data set contains the 18-question food security module which allows us to explore the link between incarceration and food insecurity and very low food security among children, families, and adults. The incidence of very low food security in our data is somewhat higher than the national average, but the incidence of other levels of food security is similar to national aggregates.

Since there is likely reverse causality in the relationship between parental incarceration and food insecurity, we employ a variety of program evaluation techniques to identify the causal relationship between food insecurity and parental incarceration. We employ imputation techniques to account for non-response among the food security variables and independent variables.

Our ordinary least squares results suggest that having at least one parent that has ever been incarcerated has a small positive effect (1 to 4 percentage points) on the probability of very low food security among children, adults and households with children, but the results are sensitive to specification and in most regressions, the incarceration variable is not significantly different from zero. Food insecurity for adults and households with children (a less dire level of food insecurity than very low food security) is affected by parental incarceration under most specifications with magnitudes of impact from 4 to 15 percentage points. This research provides some evidence that incarceration adversely affects children and families in terms of food insecurity. Policies to mitigate the impact could be addressed through the court system whereby children are provided with court-sanctioned support to address food needs.

I. Introduction

Household food insecurity is defined as "…limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Anderson, 1990). Food insecurity has been on the rise in the United States since 1999. In 2011, 14.9 percent of U.S. households experienced food insecurity, with 5.7 percent experiencing very low food security, an increase from 2010 (Coleman-Jenson, et al., 2012). Very low food security is the state in which there is a disruption in the normal quality *and* quantity of food consumed of at least one member in the household at some point during a given year (ERS, 2012). In 2011 20.6 percent of households with children were food insecure, and 10.0 percent of these households had children that experienced very low food security (Coleman-Jenson et al., 2012). Food insecurity can be very detrimental to a child's current development, and future health and productivity (Nord, 2009). In trying to understand the causes of food insecurity, we believe that an understudied population is children of incarcerated parents. The number of children with an incarcerated parent has grown steadily since 1990. In 2007, 1.7 million children had an incarcerated parent--1 in 43 children in the U.S. (Sentencing Project, 2009). The number of incarcerated parents increased by 79 percent between 1991 and 2007 (Sentencing Project, 2009).

In 2009, there were five states that experienced food insecurity above the U.S. average. Four out of these five states are among the top ten states for incarceration rates. Moreover, Black households and Hispanic households had higher rates of very low food security (United States Department of Agriculture, 2011) than the U.S. average. Given these statistics, it is interesting to

note that both African-Americans and Hispanics are more than five times more likely and more than 2 times more likely, respectively, than their white counterparts to be incarcerated over their lifetime (Bonczar, 2003). These facts provide cause to further investigate the link between food security and incarceration.

While it is true that the majority of those who are incarcerated come from the type of homes that are more likely to experience food security (poor, single-parent, and minority), there is good reason to believe that the shock of incarceration may provide an explanation for why some low-income households experience food insecurity while others do not. This is because incarceration could remove income from the household (including, in some cases, government transfer payments), incarceration imposes costs on family members (e.g., legal fees, visitation, monetarily aiding the inmate during confinement, etc.), and incarceration could have far reaching effects on parents even after release (e.g., stigma of incarceration and interruptions in the development of skills and social networks which may lead to inferior employment outcomes upon release). Nonetheless, it is possible that incarceration could act as a life changing event motivating the parent to improve their lifestyle. Moreover, many human capital development services (e.g., health services, skill development, and work programs) are offered behind-bars that may help to lessen the financial burden of incarceration and improve employment prospects upon release. Therefore, the above suggests that the theoretical effect of incarceration on food insecurity is ambiguous.

Given the impact of incarceration on the life of the inmate and his or her family, it is clear that the role incarceration plays as a predictor of low or very low food security is an empirical question that must be explored further. The current statistics on food security suggest that food insecure families are most prevalent in single parent, black or Hispanic, low income households

(USDA 2009). This profile is similar to that of incarcerated parents. It is important to disentangle the marginal impact of incarceration on food insecurity among children in order to better focus current policies and reduce the probability of food insecurity. Therefore, this study seeks to provide a first attempt at identifying the causal mechanism of incarceration on food insecurity through the use of state of the art program evaluation techniques.

Incarceration-Food Security Link

Incarceration may impact food security of children by removing the incarcerated parent as a source of income for the child. However, not only does incarceration hinder the imprisoned parent from financially providing for their children, incarceration may act as a shock to the household by placing an additional financial strain on the family (Grinstead et al., 2001). Incarceration may place a direct strain on the immediate family unit as well as a strain on other relatives. Children of incarcerated parents often go to live with a grandparent (Mumola, 2000).[1] Ziliak et al. (2008) finds that senior households living with a grandchild are at higher risk of hunger.

Moreover, incarceration may limit the upward mobility of offenders and their families through three mechanisms: stigma, acquiring human capital, and obtaining social capital. Incarceration marks offenders as "untrustworthy" making it difficult for them to find employment. For example, offenders with felony records may be temporarily unable to find employment in licensed or professional positions, as well as public sector employment in some states. In addition, incarceration may weaken offenders' job skills, hinder their attainment of job skills compared to those who are free, and lower their productivity through attrition of human capital (Cox, 2010). Empirical evidence suggests incarceration has little effect on employment,

[1] 13.3% of children with fathers incarcerated and 52.9% of children with mothers incarcerated live with a grandparent.

but has a significant negative effect on earnings (Grogger, 1995, Western et al., 2001, Kling, 2002, Holzer, 2007).

Finally, there are collateral consequences to incarceration. Collateral consequences are statutory restrictions imposed on the offenders in addition to the convictions and sentences administered by the courts (Olivares et al., 1996). These limitations include prohibitions on voting, parenting, public employment, as well as debarment for certain federal benefits such as TANF, food stamps (SNAP), and public housing (American Bar Association, 2009, Sentencing Project 2009).[2] Incarceration may place a ban on qualified low-income families' participation in public assistance programs that would help to alleviate or lower the risk of food insecurity. Somewhat ironically, this is done at a time when these families are known to the corrections system and by extension to other public institutions. There is also some evidence to suggest that stricter child support enforcement during and after incarceration can also reduce work incentives for non-custodial fathers (Holzer, 2005).

It is also possible that incarceration could act as a life altering event for the incarcerated parent causing him or her to move away from a life of crime. Moreover, due to the availability of human capital investment programs behind bars, confined parents may leave prison or jail with an increased skill set. These events may allow the incarcerated parent to improve their life circumstances upon release, and the circumstance of their children. There is an additional argument that incarceration may benefit the family by taking the "bad apple" out of the

[2] Jailed individuals do not receive SNAP benefits and convicted drug felons face a life-time ban from receiving SNAP benefits in 13 states: Alabama, Alaska, Arizona, Arkansas, Florida, Georgia, Indiana, Mississippi, Missouri, North Dakota, South Carolina, Texas and West Virginia (National Re-entry Resource Center, 2012, http://www.nationalreentryresourcecenter.org/documents/0000/1085/Reentry_Council_Mythbuster_SNAP.pdf). Children of incarcerated parents do not technically lose SNAP benefits. However, the household benefit is reduced by the amount allocated to the incarcerated adult (although their income is not included in the aid calculation for the remaining household members). In addition, based on interviews with advisors at Atlanta Legal Aid, if the incarcerated parent is the designated head of household, there may be a lapse in SNAP coverage for their children while the legal guardian gets "reconnected" to the SNAP benefit system.

household, thereby reducing negative influences within the household. At the extreme, this could potentially afford those remaining in the household opportunities to access education, employment, and services to increase food security.

The causal relationship between food security and incarceration is complex. Most of the preceding arguments suggest that food insecurity is caused, in part, by incarceration. In turn, it is plausible that incarceration is a function of food security as financially and emotionally stressed parents engage in criminal activity to feed their families.

Given the discussion above, it is clear that the mechanisms through which incarceration influences the food security of children must be identified empirically. Therefore, the remaining portion of this paper will seek to develop and test an empirical framework to better understand the causal role of parental confinement on food insecurity among families with children using micro-level data from the Fragile Families and Child Wellbeing Study.

II. Data

The Fragile Families and Child Wellbeing Study (FFCWS) is a longitudinal study that is currently following a set of 4,898 families that gave birth to a child in 20 sizeable (200,000 or more population) U.S. cities between the years 1998 and 2000. These families are classified as "fragile" because many of the parents are not married; and, as a result, are at greater risk of dissolving relative to traditional families. The study uses a survey interview methodology administered to both the mother and father at birth and again at ages one, three, five and nine (referred to as waves).[3] Each wave includes a series of core surveys. The baseline core survey is a hospital based survey taken at birth of the child. Follow up core surveys are telephone surveys

[3] In 2012, the nine-year follow up interview and in-home survey became available. This wave did not capture incarceration and food security variables that were consistent with the previous surveys. Therefore, we are not able to use that wave in our analysis.

of the mother and father at ages 1, 3, 5, and 9. At ages 3, 5, and 9 there is also an in-home assessment and various supplemental surveys (see Figure 1 for more information).

The surveys collect information on parental history and behavior, health of parents and children, socio-economic conditions, public program participation, demographic information, and the environmental conditions in which the child is raised. Most importantly, FFCWS also contains food security questions in-line with the Core Food Security Module (CFSM) in the ***third and fifth year in-home assessment survey***, and detailed information on parental incarceration. Another major benefit of using FFCWS is that it surveys both the mother and the father about the other parent. This allows for a degree of cross-checking of responses to various questions.

In general, we restrict our data to only those years that contain the Core Food Security Module: years 3 and 5. As mentioned earlier, there are 4,898 families in the base data. Of these families, 3,288 families responded to the third-year core survey and the third year in-home survey and 3,001 responded to the fifth-year core survey and the fifth year in-home survey. There are 2,489 observations for which there are responses for the baseline core survey, and the third and fifth year surveys.[4]

The CFSM questions are critical to this research. There are eighteen food security questions in the module. The food security module is designed to allow administrators to implement two common screens (and a third less common screen) when it appears the food security questions may pose an unnecessary burden on the respondents.[5] While it is not a requirement to employ

[4] The observations lost moving from the third to the fifth wave are not significantly different in terms of the mean value of the following important characteristics: mothers'/fathers' incarceration, mothers'/fathers' income, low/very low food security among households with children, low/very low food security among adults, and very low food security among children.

[5] The first screen is comprised of the first five questions of the FFCWS food security module (questions d1a-d1e listed in Appendix A-1). If a respondent answers in the affirmative to any of these five food security questions, then they continue to the second stage of the survey comprised of the next six questions (questions d3-d7 also listed in Appendix A-1). If the respondent answers "never true" to all 5 questions in the first stage, they can skip the remaining questions of the survey. Note that we screened individuals out in the first stage if a respondent answered

these screens, it appears that all three were used in the FFCWS food security questions. Utilizing recognized patterns of non-response, we imputed responses for all but 57 observations using the methodology detailed in Bickel et al 2000.[6]

An additional complication in our analysis is defining incarceration to capture the event of removal from the family. As in previous research on incarceration using the FFCWS, we used multiple means to capture the incarceration variable including comparing the mother's response with the father's response and information from the previous survey for those who responded to multiple surveys to clarify answers.

There are missing data for a number of variables (including incarceration) and the percent missing ranges from a high of 49.2 percent for parent earnings, 29 percent for adults and children in father's family, 28 percent for parent's employment (in weeks) to a low of less than 1 percent for: adults in mother's family, children in mother's family, mother's age, mother's race, father's race, and parent's living situation.

We impute values for many variables using STATA's multiple imputation (MI) by chained equations methodology (MICE). Following van Buuren and Oudshoorn (1999), let $X = (X_1,X_2,\ldots,X_k)$ be a set of k random variables where each variable may have some missing observations. The dilemma for imputation is to pull from P(X), the unconditional multivariate distribution of X. Allowing t to represent the number of iterations, and assuming the data are missing at Random (MAR), one may replicate the subsequent series of Gibbs sampler iterations:

For X_1*: draw imputations* X_1^{t+1} *from* $P(X_1|X_2^t,X_3^t,\ldots,X_k^t)$

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at least one of the first five questions in the negative with missing values for the remaining questions in the first level internal screen. Those who move on to the second stage are screened out (i.e., they do not have to answer questions d9-d13) if they respond negative to all questions in this second stage, otherwise, they move on to the remaining six questions in the third stage of the survey (questions d9-d13). A less common screen is implemented in FFCWS that allows the respondent to skip question d13 if they had a negative response to question d12.

[6] We acknowledge the help of Mark Nord in implementing these adjustments. Any errors are ours.

For X_2: draw imputations X_2^{t+1} from $P(X_2|X_1^t, X_3^t, \ldots, X_k^t)$

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For X_k: draw imputations X_k^{t+1} from $P(X_k|X_1^t, X_2^t, \ldots, X_{k-1}^t)$

In other words, the above iterations specify that one "…conditions each time on the most recently drawn values of all other variables" (p. 9,van Buuren and Oudshoorn, 1999). If we assume P(X) is multivariate normal, then linear regression models such as

$$X_1 = X_2^t\beta_{12} + X_3^t\beta_{13} + \ldots + X_k^t\beta_{1k} + \varepsilon_1, \text{ with } \varepsilon_1 \sim N(0,\sigma_1^2)$$

for a continuous variable and logistic regression for binary variables can be used to obtain a random draw from the preferred distribution. For our analysis, X includes mother, father and parent incarceration status, number of adults in fathers' household, number of children in fathers' household, fathers' age, sum of parental earnings, sum of parents' education, and sum of the total number of weeks parents were employed.

If it is also assumed that the multivariate distribution exists, and that values pulled from it can be produced by iteratively selecting from the conditional distribution, the multivariate imputation puzzle can be separated into a chain of univariate problems. The imputed data for the multivariate case is then estimated using the regression switching, or variable-by-variable, imputation method (van Buuren and Oudshoorn, 1999). This technique is then used to create a set of Y imputed data sets (often 10 to 100), *with estimation being performed on each of t*he imputed data set and the final results are averaged over the *J* data sets (Rubin 1987, Donders et al 2006, Little and Rubin 2002). We report results using the imputed data as well as those from original data (with list-wise deletions of missing variables). In general, the results between imputed and original are quite similar.

Table 1 provides a comparison of the incidence of food insecurity in the FFCWS data (weighted) and national statistics from USDA using wave 3 data. The comparisons are not straightforward for several reasons. First, when appropriately weighted, the FFCWS is representative of births in large U.S. cities.[7] Secondly, the various waves of FFCWS data are established based on the birth year of the child (birth year from 1998 to 2000) and the follow up year (one year old, three years old, etc.) so that the waves are not coincident with one calendar year (the three year wave, which is the first follow up year with the core food security module, includes families in years 2001, 2002, and 2003). The FFCWS is also a longitudinal data set anchored by the birth of a child. As a result, the mean age of children in the FFCWS is relatively young. Finally, as noted above, the food security responses were imputed for many observations and while this is consistent with USDA's imputation methodology, there may be some minor measurement error in the FFCWS statistics presented in Table 1.

Overall, the percent of households with children in the FFCWS weighted data that are food secure is similar to the percent reported nationwide (85.2 percent and 83.3 percent respectively). The percent of children who are food insecure is somewhat smaller in the FFCWS data versus what is reported nationally (15.5 percent versus 18.2 percent), but the percent of children with very low food security is larger in the FFCWS data than what is reported nationally (1.3 percent versus 0.6 percent).

Given the structure of the FFCWS data, we might expect the incidence of food insecurity to be larger than reported in the national data at least for the unweighted data, but this is not the case. We have analyzed the data carefully and do not have a definitive answer to the issue.

[7] The FFCWS data reported in Table 1 are weighted by the national weights. According to the FFCWS survey team, the "national weights are designed to make the data in the 16 randomly selected cities in the national sample to be representative of all births in large US cities (cities with populations over 200,000 in 1994) between 1998 and 2000. They are designed to correct for the oversample of nonmarital births, non-response at baseline, and attrition based on observed characteristics at each wave." (email correspondence 10/29/2012 and FFCWS, April 2008).

When we break down the comparison by income groups (relative to the poverty level), the FFCWS data set contains very few observations at income levels less than 300 percent of poverty. It is possible that the sampling design did not lead to a representative sample along the food security spectrum. It is also possible that there were errors in administering the food security questions. We find similar results for basic food insecurity using wave 5 observations, but for VLFS among children, the wave 5 FFCWS rates are smaller than national levels reported by USDA (with fewer observations than in wave 3). The higher incidence of very low food security in wave 3 may be accounted for in part by the 2000-01 recession encompassing wave 3 observations.

There is less information about very low food security among children at geographic units below the national level—in fact we could not find any such data. The percent of children with very low food security in the weighted sample of cities included in the FFCWS (wave 3) is double that reported for the U.S. (1.3 versus 0.6 percent). This suggests that there is potentially a different dynamic between food insecurity and very low food security in cities versus the average population. However, as noted above we are wary of the significance of the difference in the percent of children with very low food security in the FFCWS versus the national results because of the small sample size and the reverse. At the least, we believe that this observation warrants further analysis on the potential differences in intensity and dynamics of food insecurity for children in urban areas.

Table 2 provides summary statistics (unweighted) for the variables used in this analysis.[8] The table also reports the mean value of the imputed data for variables that were imputed using the MICE procedure. The mean values for the food security variables show that food insecurity is more common at the household level than among children in the household. The median

[8] Table 2 reports statistics for wave 3 and 5.

education for the father and mother is a high school diploma or GED. [9] Thirty-four percent of families reported a father ever incarcerated and five percent of families report a mother incarcerated.[10] The average age for the mothers in our sample is 29 and the average father's age is 31. Using the mother's information, most families are intact about half of the time (mtogether4). Finally, 22 percent of the mothers and 19 percent of the fathers are non-Hispanic white; 50 percent of the mothers and 52 percent of the fathers are non-Hispanic black; 25 percent of the mothers and 26 percent of the fathers are Hispanic; and 3 percent of the mothers and 3 percent of the fathers are classified as other.

III. Research Methods

Our research question is whether incarceration increases the probability of very low food security for children. We think it is important to understand the impact of incarceration on food security for the adults and households as well and so we estimate a series of food security measures as a function of incarceration and additional explanatory variables.

Since many of those incarcerated come from households that are more likely to experience food insecurity, we cannot rely on simple OLS to determine if the shock of incarceration leads to increased food insecurity among households with children, although it is useful to start with a simple OLS/probit specification to explore basic correlations. We expand our empirical analysis to program evaluation techniques in order to identify as best possible, causal effect of incarceration on food security. In particular, we will think of incarceration as a "program" that

[9] The education variable for the baseline year of the survey for the mother and the father is defined as follows: no formal education =1, less than an 8th grade education=2, some high school=3, high school diploma or GED=4, some college or technical training=5, a BA or BS=6, and graduate school=7. In each follow up survey if the mother or father indicated they have completed a degree higher than the degree they had in the previous wave, then, the education level is updated.

[10] The prevalence of incarceration in FFCWS is high, even after weighting our analysis. However, they are in line with other studies (Geller, Garfinkel, Western, 2011). The high levels of incarceration are most likely due to the sampling design (incarceration is correlated with lower rates of marriage) and the fact that urban areas have higher rates of incarceration (Charles and Luoh, 2010,Wildeman and Western, 2010,Western and Wildeman, 2008, Pettit and Western, 2004, Western and McLanahan, 2000).

parents choose to participate in (through their decision to partake in illegal behavior). In doing so, we will implement a two-step propensity score matching technique to identify the impact of incarceration on food insecurity among households with children. The first stage of the analysis will use propensity score matching to create our matched sample, and the second stage will model the relationship between food insecurity and incarceration in a regression framework in order to get more precise results. Since propensity score matching only solves the selection problem based on observable traits, our results could still be biased by unobservable characteristics. We therefore also employ a difference-in-difference estimation strategy that seeks to identify the causal relationship between food insecurity and incarceration. Finally we also estimate the impact of incarceration at birth on food security in wave 3 (and wave 5). Unless food security is a chronic problem, in this treatment, incarceration is predetermined, and not endogenously determined at wave 3 and 5.

We begin with the ordinary least squares (OLS) regression model to estimate the following equation:[11]

$$(1) FIS_{it} = \mu + \delta_1 PInc_{it} + X_{it}\beta + \alpha_1 year5 + d_{it} + \varepsilon_{it},$$

where:

FIS_{it}: equal to 1 if household i suffers from food insecurity (various measures including very low food security for children) at time t,

X_{it}: a vector of covariates for household i at time t affecting food security such as household income, employment, public assistance program participation, mother's education, father's education, household size, household composition, race, age (Rose, 1999),

$PInc_{it}$: equal to 1 if either the mother or the father has been incarcerated by time t for household i,

year5: a time fixed effect equal to 1 if the interview period for the survey is the fifth year follow up wave,

[11] We also estimate this equation using a probit specification.

d_{it}: an indicator variable equaled to 1 if the family responded in year t of the survey,

ε_{it} : error term.

The above analysis will provide a reasonable estimate of δ_1 given the classical linear model assumptions hold. However, it is very possible that our model suffers from endogeneity due to omitted variable bias and simultaneity between parental incarceration and food insecurity causing the zero conditional mean assumption of the error term to fail.

In order to control for omitted variable bias, we can exploit the longitudinal nature of our data and estimate the following equation using the feasible generalized least squares (FGLS) estimator known as the error components model (ECM):

$$(2) FIS_{it} = \mu + \delta_1 Pinc_{it} + X_{it}\beta + year5 + d_{it} + u_{it},$$

Where u_{it} is the error term equal to $\eta_i+\varepsilon_{it}$. With this model, it is assumed that the individual-specific effects, η_i, are manifestations of iid random variables, and are uncorrelated with the independent variables (Cameron and Trivedi, 2005). There still remain two possible sources of endogeneity with this model: 1) reverse causality between parental incarceration and food insecurity, and 2) unobserved heterogeneity caused by time-varying omitted variables. Moreover, this model will be inconsistent if η_i is correlated with the independent variables in the equation.

Due to the concerns above, we implement three techniques to control for the potential correlation between the individual-specific effects and the independent variable, and the possible endogenous relationship between parental incarceration and food insecurity. The first strategy exploits the panel nature of our data by using a difference-in-difference (DID) estimator. In particular, our data include information on incarceration at various collection points (years three and five). Therefore, we restrict our model to only those observations that are not incarcerated in

the third year interview of the panel and use the change in parental incarceration status between the third and fifth year (no incarceration to incarcerated) in order to control for time invariant observed and unobserved factors affecting food security for families in which at least one parent is incarcerated between the third year and fifth year follow up survey. This restricts the sample to approximately 1,500 observations (before imputation for the right hand side variables), which is an admittedly selected sample and limits our ability to generalize to the at risk population. However, we believe this to be an important modeling strategy to identify the causality. Our model takes the following form:

$$(3) FIS_{it} = \mu + \delta_1 PInc_{it} + \alpha_1 year5 + \gamma_1 PInc_{it} * year5 + X_{it}\beta + \varepsilon_{it},$$

where $\hat{\gamma}_1 = (\overline{FIS}_1^T - \overline{FIS}_0^T) - (\overline{FIS}_1^C - \overline{FIS}_0^C)$.

The parameter γ_1 gives us the average difference in the probability of food insecurity between the fifth year survey (time period 1) and the third year survey (time period 0) for those who are incarcerated between year three and year five (our treatment group) and those who are not confined between survey waves and were not previously incarcerated (our control group). The benefit of this estimator is that it removes time invariant unobserved heterogeneity between the treatment and control group, as well as biases that could be due to time trends of the dependent variable. However, the key assumption that may fail with this technique is the parallel trend assumption. This assumption requires the food insecurity time trend to be the same between the treatment and the control group. While this is a relatively common problem with the DID estimator we are unable to investigate the validity of this assumption in our analysis due to the short time frame of the panel data.

We also estimate a specification using a two-step approach that utilizes propensity score matching with regression analysis. The first step in this method seeks to match individuals who

have been incarcerated (the treatment group) to those who have not (the control group) using propensity score matching. With this method, the propensity scores are estimated using the following probit model:

$$(4) P(PInc_{it} = 1|\boldsymbol{x}_{it}) = \Phi(\delta_y + \boldsymbol{x}_{it}'\boldsymbol{\beta}).$$

Where $\Phi(\cdot)$ is the standard normal cumulative distribution function, PInc is a binary response variable equal to 1 if the parent (individual) was ever incarcerated by time t, and **x** is a vector of covariates that may impact a parent's (individual's) likelihood of being incarcerated. These regressors include the number of adults in the mother's household, the number of adults in the father's household, the number of children in the mother's household, the number of children in the father's household, a time dummy for wave 3, an indicator variable for whether or not the household is included in both in-home surveys, the mother's age, the mother's age-squared, the father's age, the father's age squared, the race of the father and mother (white non-Hispanic, black non-Hispanic, other), an indicator variable equal to one if the mother is Hispanic, an indicator variable equal to one if the father is Hispanic, and an indicator variable equal to one if the interview took place in the 3rd year follow-up. In addition, we also include two indicator variables for whether or not the family responded to the 3rd year and 5th year of the surveys. Matching then takes place, using the radius method, on the odds ratio since the predicted probabilities of being incarcerated are not consistently estimated in choice-based samples like the FFCWS (Heckman and Todd, 2009). By using propensity score matching, we have created a treatment group and a control group that can be used to investigate how incarceration impacts food insecurity. In the second stage of the analysis we will use our matched sample to re-estimate the impact of parental confinement on food insecurity using the OLS (equation 1) and ECM (equation 2) models. In doing so we will be able to calculate the average treatment effect

on the treated (the incarcerated), i.e., how incarceration has impacted the food security of children in households that have experienced parental incarceration.

Our final analysis defines incarceration by the father's incarceration status at the child's birth and evaluates food insecurity in waves 3 and 5. This analysis potentially breaks the endogeneity of the food security-incarceration relationship and assumes that there is no chronic food security-incarceration link. Intuitively, if the father was incarcerated at the time of the child's birth and if food insecurity was an issue in wave 3, incarceration is predetermined. We test this hypothesis by running the and ECM models of food security indicators as a function of incarceration and other previously defined determinants for wave 3 and wave 5 (combined and separately). For those for whom food security is chronic (before and after the birth of a child), this is somewhat less convincing an argument.

IV. Results and Discussion

Our estimation categories are as follows:[12]

	Non-imputed explanatory variables		Imputed explanatory variables	
	Incarceration	Baseline incarceration	Incarceration	Baseline incarceration
OLS[13]	√	√	√	√
Probit marginal effect	√	√		
GLS	√	√	√	√
Matching (propensity score, probit, marginal effect)	√			
Difference-in-Difference	√		√	

[12] We do not estimate every combination in this matrix as many of the results are quite similar. We provide an illustrative group of results from the models in Table 4.

[13] The OLS, Probit and GLS models do not treat the endogeneity, we simply acknowledge that incarceration in these models may be endogenous.

Incarceration refers to the models where incarceration is measured as an event that may have occurred at any time before or after birth (except in the DID case). Baseline incarceration refers to the models where incarceration is pre-determined as the value of incarceration at the birth of the child. The imputed results utilize the MI imputed data, while the non-imputed results do not. All models use the data that has been adjusted for imputations and reclassifications of the food security variables. Where possible, each estimator is run for the following classifications of food insecurity:

- Very low food security among Households with children
- Very low food security among Adults
- Very low food security among Children

- Food insecurity among Households with children
- Food insecurity among Adults
- Food insecurity among Children

Appendix Table A1 provides a copy of the food security questions as reported in the FFCWS.

We have two dependent variables—very low food security and food insecurity (a lesser level of hardship). The dependent variables are 0/1 binary variables equal to one if there is *very low food security* (or *food insecurity*) and zero otherwise. The hypothesis we test is that parental incarceration increases the probability of very low food security or food insecurity. Given our previous discussion, incarceration has a theoretically ambiguous relationship with food security status. If the direct and indirect costs of incarceration outweigh its potentially "positive" influences, our expectation is that incarceration will be positively correlated with the food insecurity dummy variables—if a parent has been incarcerated, there is an increased likelihood of food insecurity. We hypothesize that family size will also positively affect the likelihood of food insecurity. Alternatively, we hypothesize a negative relationship between the food

insecurity dummy variables and the control variables that increase family opportunities to sustain food security: parents' earnings, parents' education, and cohabitating parents. We control for parents' age and parents' race but do not assign a hypothesized value to these variables.

As discussed earlier, some of the estimation techniques are chosen to explicitly account for the endogeneity of incarceration and food security. The OLS, Probit, and GLS specifications do not control for the endogeneity, while the propensity score, difference-in-difference, and baseline incarceration models do control for the potential endogeneity of incarceration (implicitly or explicitly). We present results from many of these models to help us better understand the impact of the endogeneity test the sensitivity of the results. In this text, we focus on the incarceration coefficient but the results for all of the covariates are contained in a separate appendix.[14]

Table 3 presents the results of our specifications (the table contains six components). The first three components report results for very low food security and the remainder for the basic food insecurity measure. We begin with the basic OLS model (first entry of Table 3) for the column non-imputed incarceration. Although the dependent variable is binary, OLS can provide a reasonable estimate of the average partial effect of parental incarceration on food insecurity. The OLS point estimates are positive across specifications indicating that the negative effects of incarceration outweigh the positive influences. Nonetheless, in the case of very low food security for children, adults, and households, the level of significance is low. In the case of food insecurity the OLS results suggest a moderate and significant impact of incarceration on the probability of being food insecure on the order of 6 to 7 percentage points for adults and households with children. With these results, we believe that there is weak evidence of a small

[14] We estimated all regressions using one parental incarceration variable (whether either parent had been incarcerated) and also ran the regressions with separate variables for mother's and father's incarceration. In most cases, the results were very similar and we report the parental incarceration variable results.

impact of parental incarceration on very low food security for children, adults and households, but stronger evidence of a moderate impact of food insecurity on the adults and at the household level. A larger sample might allow us to estimate these effects with more precision.

The marginal effects of a standard probit model are reported in the second line of Table 3. The marginal effects are calculated at the mean value of the variables, marginal effect at the mean (MEM), using Stata's mfx command. The marginal effects are positive, but significance is again quite weak in the cases of very low food security of children, adults, and households with children. In the case of basic food insecurity, the marginal effects are significant for adults and households and on the order of 5 to 6.8 percentage point impact on the likelihood of food insecurity if a parent is incarcerated.

Since it is likely that we have unobserved heterogeneity in our model, we run our specification within an error components model in order to control for time invariant unobserved heterogeneity (third entry in Table 3). This model is appropriate if the individual-specific effects are random, iid, and independent of the explanatory variables included in the model.[15] The point estimate is not statistically significant for any of the very low food security models. In the case of basic food insecurity, controlling for invariant unobserved heterogeneity with the GLS model, we find slightly smaller significant impacts of incarceration on food security for adults and households with children than in the OLS case. Consistent with the probit model, these estimates show that parental incarceration causes the probability of food insecurity to increase by about 5 to 5.7 percentage points.

Turning to the matching estimator (the fourth entry in Table 3), we examine the conditions of unconfoundedness (no unobserved heterogeneity) and common support. The common support assumption was first met by dropping those observations that had propensity scores lower than

[15] If the Fixed-effects model is the true estimator, then the ECM model will be inconsistent.

the minimum and greater than the maximum of the control group. We then also dropped the 10 highest propensity score values and the 10 lowest propensity score values of the treatment and control groups. We restrict our common support criteria to families that have propensity scores that are greater than or equal to the highest minimum propensity score value and less than or equal to the lowest maximum propensity score value among this subgroup (Caliendo and Kopeinig, 2008). As can be seen from Figure 2, the common support criterion is now achieved: there is overlap among the propensity scores for each group, and both the treatment and the control groups have propensity scores that are less than 1. The balancing property was examined by using a t-test to determine if the matching process eliminated any statistically significant differences in the mean values of the control and treatment group. Matching eliminated all differences between the treatment and the control groups that are present prior to the implementation of the matching procedure for all variables included in the first stage of the propensity score model. The balancing property is not met for variables such as parental employment, parental earnings, etc. Therefore, it is important to control for these variables in our main regressions.

We use our matched sample to estimate a probit model of very low food security (and food insecurity) as a function of incarceration and the same set of independent variables used previously.[16] In the very low food security regressions, the incarceration variable is positive but not significant for children and households. The coefficient is significant for adults, albeit quite small in magnitude (0.0155). In the cases of basic food insecurity in the adult and household regressions, incarceration is positive and statistically significant and of similar magnitude to the previously reported OLS, probit and GLS estimates at about 6.4 to 7.8 percentage points.

[16] We also used the matched data to estimate OLS and GLS models. The results are not qualitatively different.

Finally, we restrict our analysis to only those households that did not have at least one parent incarcerated by the third year follow-up survey and estimate our model using the DID approach. The DID estimator allows us to control for time trends in food insecurity as well as difference out time-invariant unobserved heterogeneity between the treatment and the control group. The generally positive coefficients are not significant in any case.

Turning to the second column of results, we identify incarceration based on whether or not the father was incarcerated at birth (we do not have information on the mother's incarceration status at birth). In this case, incarceration is predetermined and the issues associated with endogeneity are eliminated. We use OLS, Probit and GLS estimators with this "baseline" specification. For very low food security among children, the coefficient on baseline incarceration is positive, but the OLS estimate is significant. The OLS point coefficient suggests that a child with a parent incarcerated at birth is more likely to experience very low food security (4.3 percentage points) than a child without an incarcerated parent. The other estimators are not significant.

For the basic food insecurity analyses, we see that in the baseline incarceration, the coefficient for incarceration is positive and significant for adults and that these seem to be driving the result for households. These coefficients are statistically significant and relatively large ranging in magnitude from 0.07 to 0.146.

As reported above, we imputed a series of independent variables (including incarceration) using multiple imputation by chained equations. In general, the results from the various models using imputed data are similar to those of the original data but the magnitudes differ. When the coefficients are significant, we find the magnitude of the effect to be smaller using the imputed data. For example, the coefficient for incarceration in the very low food security regressions for

adults (OLS) was 0.0186 for the non-imputed data and 0.0128 for the imputed data. m the original data and are also included in the results' tables.

Among the other covariates, the strongest performers in terms of consistent sign and significance are the education of the parents and parents' income. The size of these coefficients is typically less than 3 percentage points.

V. Conclusions

Food insecurity has been on the rise in the United States. Households with children are at greater risk of experiencing food insecurity. In 2010 roughly 20 percent of households with children and almost 10 percent of children encountered food insecurity at some point during the previous year. Food insecurity among children is of concern because it not only leads to poor development in the present, but it can also impact a child's ability to live a healthy and productive life as an adult.

In this study, we used data from the FFCWS to estimate the impact of parental incarceration on very low food security of children and other levels of food insecurity of children, adults and families. The number of observations for very low food security for children is small, (30 observations in wave 3 and 20 observations in wave 5), and this is a challenge for the estimation. We find that incarceration is universally positively correlated with measures of food insecurity, but many of our results are not significant at standard confidence levels. Where incarceration is significant, it affects the probability of very low food security among children by approximately 4 percentage points.

Incarceration of a parent is positively correlated with food security measures for adults and households with children. The magnitudes of significant impacts for these populations range from 4 to 15 percentage points. We have not identified the specific path of the incarceration-

food insecurity interaction, but it is important to note that incarceration may add to food insecurity in the population.

We envision that this analysis will be the first of many that seek to identify the relationship between incarceration and food insecurity. Our future research goals are to conduct an in depth analysis into the causes of missing data for the food security questions that pertain to children, and to collect more data in order to test the generalizability of our results.

Incarceration can lead to loss of public services. If this were significant, incarceration could increase food insecurity if services including SNAP and TANF were at risk. To test the evidence of this relationship, we estimate the number of TANF eligible families and their reported usage of TANF ("take-up"), and cross-tabulate this with parental incarceration. The variables included in the FFCWS do not allow us to perfectly identify eligibility since it is a function of earnings and other income as well as location. We do not have these data and instead, we estimate the eligibility of families as if they lived in Milwaukee (a relatively generous TANF location) and Indianapolis (a less generous location). We then compare eligibility to reported use of TANF (any use greater than zero) and calculate take-up: number of observations that report receiving TANF/number of observations that are eligible. We tabulate this take-up for observations in which a parent was ever incarcerated and those for which there was no incarceration. The incarcerated observations had a larger take-up rate than the non-incarcerated. Given the imputations needed to estimate eligibility we do not consider these results definitive, but they are certainly not in the direction we expected. This is another area in need of additional research.

As a result of this analysis, we believe that there are a number of issues that need additional research. There is need for large samples of families like those studied in the FFCWS to better understand if the baseline levels of food security in the FFCWS are accurate. The small number

of observations for various categories of food insecurity can make it difficult to analyze causal effects of food security. With the backbone of the FFCWS in place, an expanded sample of new births (doubling in size) would be a substantial improvement in the ability to analyze food insecurity as well as other important policy related issues.

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Table 1: Food Security 2003: National Data and Fragile Family Data Comparison

Unit	Data source	Total (1,000s)	Number Food secure (1,000s)	Food Insecure (1,000s)	Number Very Low Food Security (1,000s)
			(percent of total unit)	*(percent of total unit)*	*(percent of total unit)*
Households with children	USDA	40,286	33,575	6,711	207
			83.3%	*16.7%*	*0.5%*
	FFCWS	814	694	121	13
			85.18%	*14.82%*	*1.65%*
Children in Household	USDA	72,969	59,704	13,265	420
			81.8%	*18.2%*	*0.6%*
	FFCWS	1,847	1,560	286	24
			84.5%	*15.5%*	*1.3%*

Sources: USDA source is "Household Food Security in the United States, 2005" Tables 1B – year 2003; FFCWS source is the Fragile Families and Child Well Being Study data file.
Notes: The FFCWS figures calculated above should be representative of data from households with children in U.S. large cities that had a child between 1998 and 2000 and the data are weighted by the third year weights for national representation.

Table 2: Descriptive Statistics Waves 3 and 5 *(value of imputed data)*

Variable	Description	N	Mean	Min	Max
pedu	Total parents' education (years)	6075	8.56 *(8.56)*	3	14
pemp	Parents' employment (weeks)	4577	71.0 *(70.2)*	0	104
msizea	Adults in mother's family	6260	2.00 *(2.0)*	1	9
msizek	Children in mother's family	6260	2.43 *(2.42)*	0	11
fsizea	Adults in father's family	4515	2.18 *(2.20)*	1	14
fsizek	Children in father's family	4515	1.67 *(1.52)*	0	10
lpearn	Parent's earnings (log)		*(10.22)*		
mage	Mother's age	6286	29.1 *(29.1)*	16	50
fage	Father's age	4754	31.8 *(31.6)*	17	71
mrace1	Mother's race = White/Non-Hispanic	6274	0.22 *(0.21)*	0	1
mrace2	Mother's race = Black/Non-Hispanic	6274	0.50 *(0.50)*	0	1
mrace3	Mother's race = Hispanic	6274	0.25 *(0.25)*	0	1
mrace4	Mother's race = other	6274	0.03 *(0.03)*	0	1
frace1	Father's race = White/Non-Hispanic	6260	0.19 *(0.19)*	0	1
frace2	Father's race = Black/Non-Hispanic	6260	0.52 *(0.52)*	0	1
frace3	Father's race = Hispanic	6260	0.26 *(0.25)*	0	1
frace4	Father's race = other	6260	0.03 *(0.03)*	0	1
mtogether1	Parents never live together = 1	6281	0.51 *(0.51)*	0	1
mtogether2	Parents rarely live together = 1	6281	0.005 *(0.005)*	0	1
mtogether3	Parents sometimes live together = 1	6281	0.02 *(0.02)*	0	1
mtogether4	Parents always live together = 1	6281	0.46 *(0.46)*	0	1
bothinhome	Responded to both in-home surveys	6289	0.79 *(.079)*	0	1
finc	Father ever incarcerated by/in wave 3	5910	0.34 *(0.34)*	0	1
minc	Mother ever incarcerated by/in wave 3	6092	0.05 *(0.05)*	0	1
foodinsec	Food insecurity among HH with children	6232	0.16	0	1
foodinsec_ac	Food insecurity among children	6232	0.08	0	1
foodinsec_ad	Food insecurity among adults	6117	0.12	0	1
vlowfdsec	Very low food security among HH with children	6117	0.04	0	1
vlowfdsec_ac	Very low food security among children	6232	0.01	0	1
vlowfdsec_ad	Very low food security among adults	6117	0.04	0	1

Source: Authors tabulations of FFCWS data for wave 3 and 5, *mean of imputed data*

Table 3: Estimation Results by Level of Food Insecurity: Coefficient of Parental Incarceration
(standard error, number of observations, R-square)

Very Low Food Security among Children			
	Non-imputed explanatory variables		Imputed explanatory variables
	Incarceration	Baseline incarceration	Incarceration
OLS	0.0050 *(0.0041, 2947, 0.016)*	0.0431* *(0.0278, 2264, 0.0326)*	0.0012 *(0.0031, 6232)*
Probit (marginal effect)	0.0019 *(0.0017, 2680)*	0.0163 *(0.0128, 2063)*	
GLS	0.0044 *(0.0038, 2947)*	0.0410 *(0.0322, 2264)*	0.0007 *(0.003, 6232)*
Matching (propensity score, probit, marginal effect)	0.002 *(0.0019, 2472)*		
Difference-in-Difference	*Insufficient observations*		*Insufficient observations*

Very Low Food Security among Adults			
	Non-imputed explanatory variables		Imputed explanatory variables
	Incarceration	Baseline incarceration	Incarceration
OLS	0.0186 *(0.010, 2864, 0.021)*	0.0383 *(0.036, 2233, 0.0354)*	0.0128 *(0.0067, 6117)*
Probit (marginal effect)	0.0155* *(0.0082, 2763)*	0.0174 *(0.0183, 2081)*	
GLS	0.0178 *(0.010, 2894)*	0.0390 *(0.041,2233)*	0.0098 *(0.0066, 6117)*
Matching (propensity score, probit, marginal effect)	0.0197* *(0.0092, 2488)*		
Difference-in-Difference	0.046 *(0.0384, 1513, 0.0235)*		-0.0092 *(0.020, 2411)*

Very Low Food Security among Households with Children				
	Non-imputed explanatory variables		Imputed explanatory variables	
	Incarceration	Baseline incarceration	Incarceration	Baseline incarceration
OLS	0.0125 *(0.0094, 2894, 0.024)*	0.0365 *(0.0362, 2233, 0.029)*	0.0060 *(0.007, 6117)*	0.022 *(0.0185,)*
Probit (marginal effect)	0.0096 *(0.0069, 2763)*	0.0158 *(0.0172, 2081)*		
GLS	0.0110 *(0.0097, 2894)*	0.0375 *(0.041, 2233)*	0.0033 *(0.0067, 6117)*	0.026 *(0.0203,)*
Matching (propensity score, probit, marginal effect)	0.0109 *(0.0075, 2556)*			
Difference-in-Difference	0.058 *(0.045, 1513,*		0.0013 *(0.024, 2411)*	

	0.0255)			

Table 3: continued

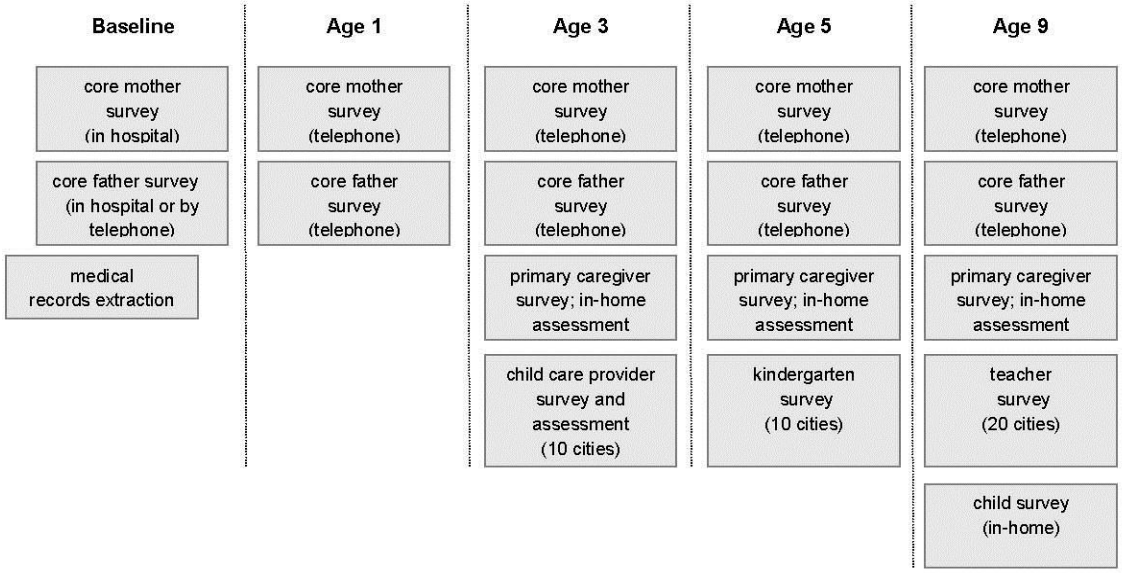
Food insecurity among Children				
	Non-imputed explanatory variables		Imputed explanatory variables	
	Incarceration	Baseline incarceration	Incarceration	Baseline incarceration
OLS	0.0082 *(0.0133, 2947, 0.038)*	0.0263 *(0.0428, 2264, 0.047)*	0.0135 *(0.0096, 6232)*	0.0278 *(0.027,)*
Probit (marginal effect)	0.0078 *(0.0102, 2947)*	0.0088 *(0.0228, 2264)*		
GLS	0.0068 *(0.0133, 2947)*	0.0265 *(0.045, 2264)*	0.0117 *(0.0096, 6232)*	0.0332 *(0.0263,)*
Matching (propensity score, probit, marginal effect)	0.0098 *(0.011, 2731)*			
Difference-in-Difference	0.0444 *(0.0516, 1538, 0.045)*		0.0272 *(0.0452, 2455)*	

Food insecurity among Adults				
	Non-imputed explanatory variables		Imputed explanatory variables	
	Incarceration	Baseline incarceration	Incarceration	Baseline incarceration
OLS	0.0632*** *(0.0169, 2894, 0.055)*	0.1253* *(0.057, 2233, 0.058)*	0.0384*** *(0.0114, 6117)*	0.086** *(0.0294,)*
Probit (marginal effect)	0.0557*** *(0.015,2894)*	0.075* *(0.042, 2233)*		
GLS	0.0522** *(0.016, 2894)*	0.1363* *(0.060, 2233)*	0.0296*** *(0.011, 6117)*	0.0981** *(0.0332,)*
Matching (propensity score, probit, marginal effect)	0.0636*** *(0.0159, 2677)*			
Difference-in-Difference	0.0415 *(0.0712, 1533, 0.047)*		0.0199 *(0.0499, 2411)*	

Food insecurity among Households with Children				
	Non-imputed explanatory variables		Imputed explanatory variables	
	Incarceration	Baseline incarceration	Incarceration	Baseline incarceration
OLS	0.0772*** *(0.0186, 2947, 0.072)*	0.1265* *(0.059, 2264, 0.065)*	0.0485*** *(0.0127, 6232)*	0.0901** *(0.0312,)*
Probit (marginal effect)	0.068*** *(0.0169, 2967)*	0.072* *(0.044, 2264)*		
GLS	0.0574*** *(0.0172, 2947)*	0.146* *(0.062, 2264)*	0.0384*** *(0.0122, 6232)*	0.1024*** *(0.0347,)*
Matching (propensity score, probit, marginal effect)	0.0776*** *(0.0178, 2714)*			
Difference-in-Difference	-0.0123 *(0.0809, 1538, 0.062)*		0.0148 *(0.0588, 2455)*	

Notes: Baseline results are for combined wave 3 and wave 5.
"*" significant at the 5% level, "**" at the 1% level and "***" at the .1% level

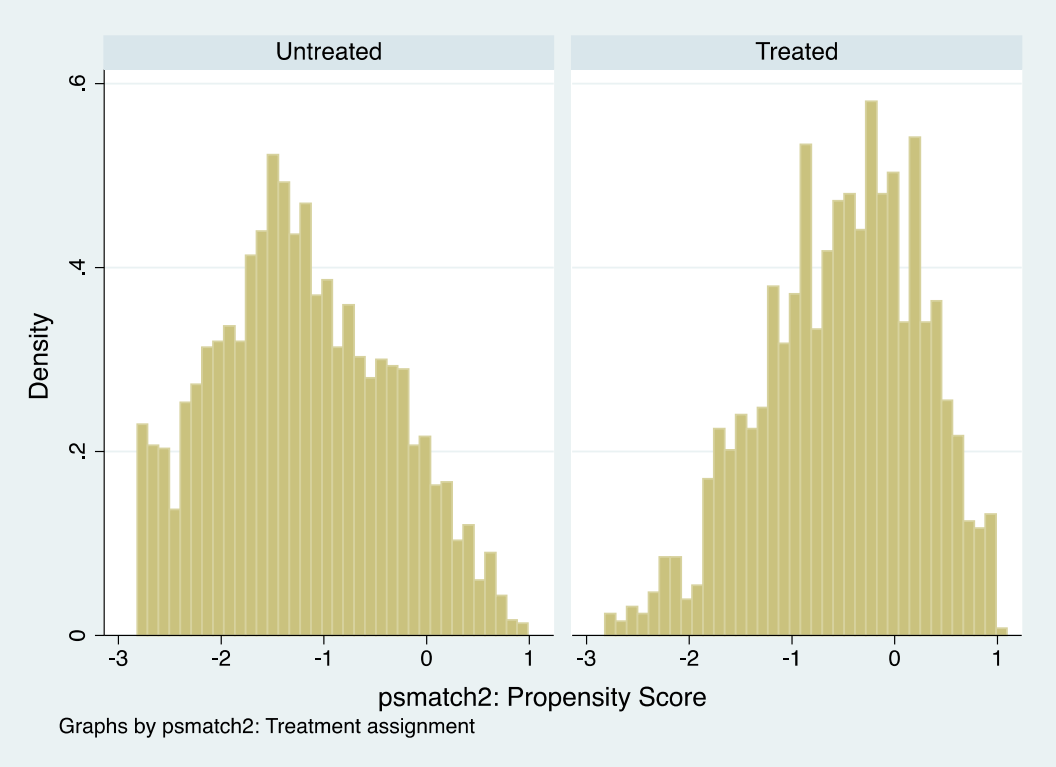
Figure 1: Fragile Families Survey Waves



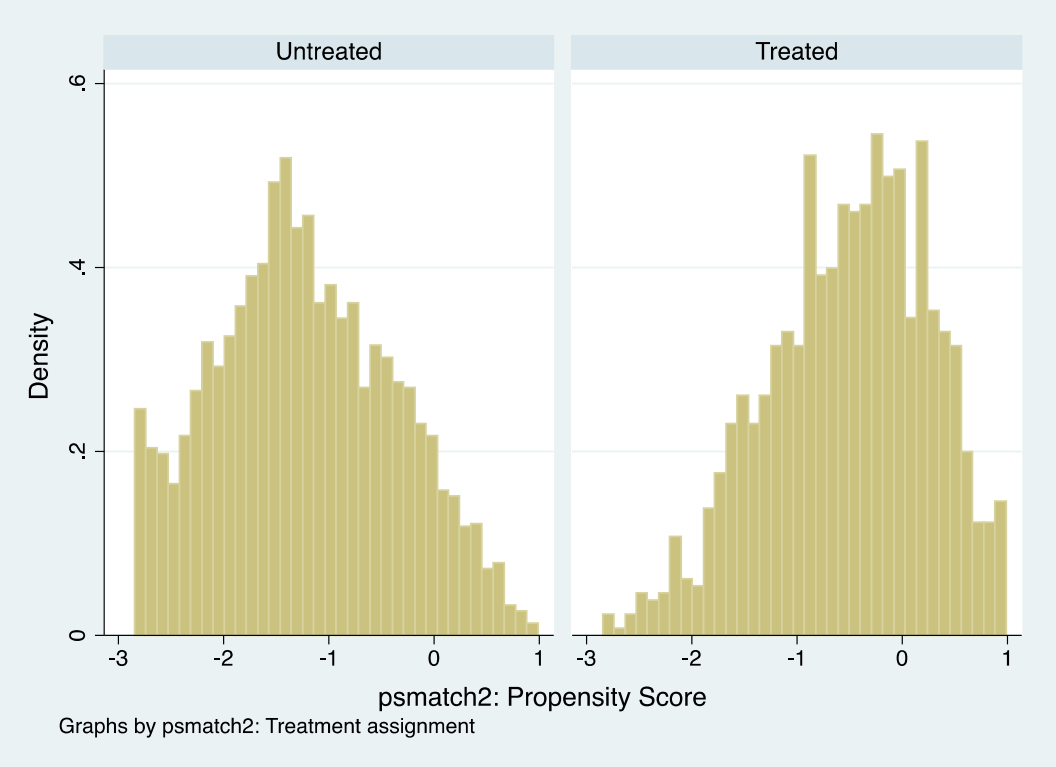
Source: The Center for Child Well-Being (2012) **http://www.fragilefamilies.princeton.edu/study_design.asp**

Figure 2: Common Support Assumption (All Cases)

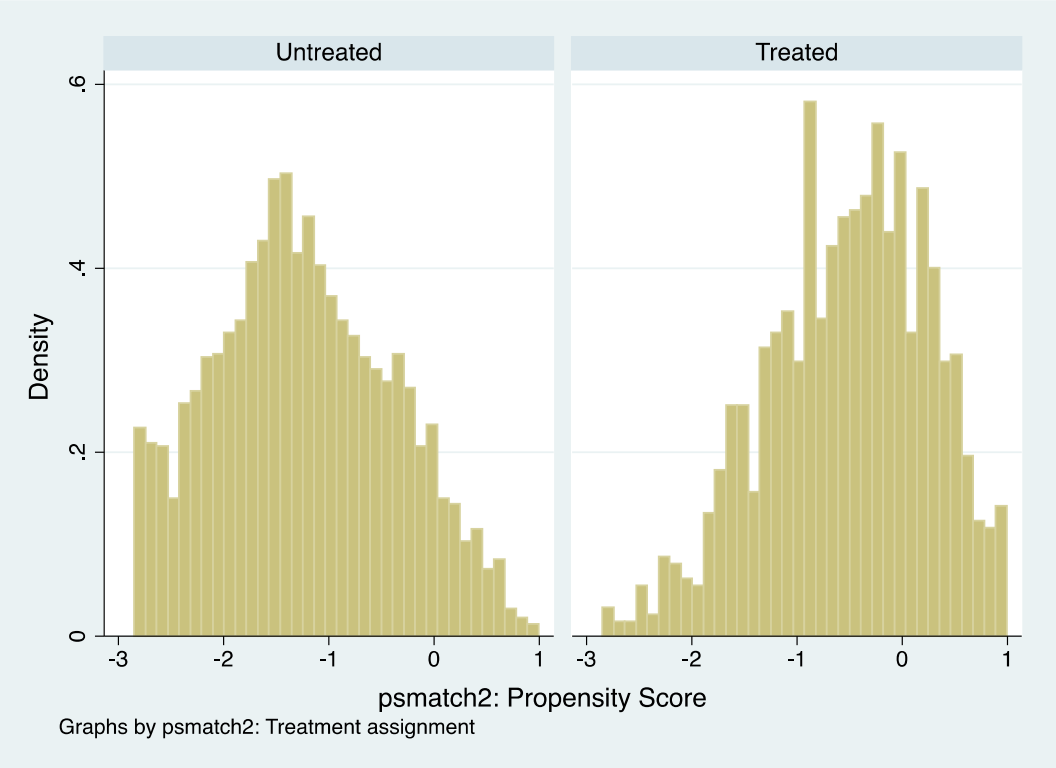
Household Food Insecurity



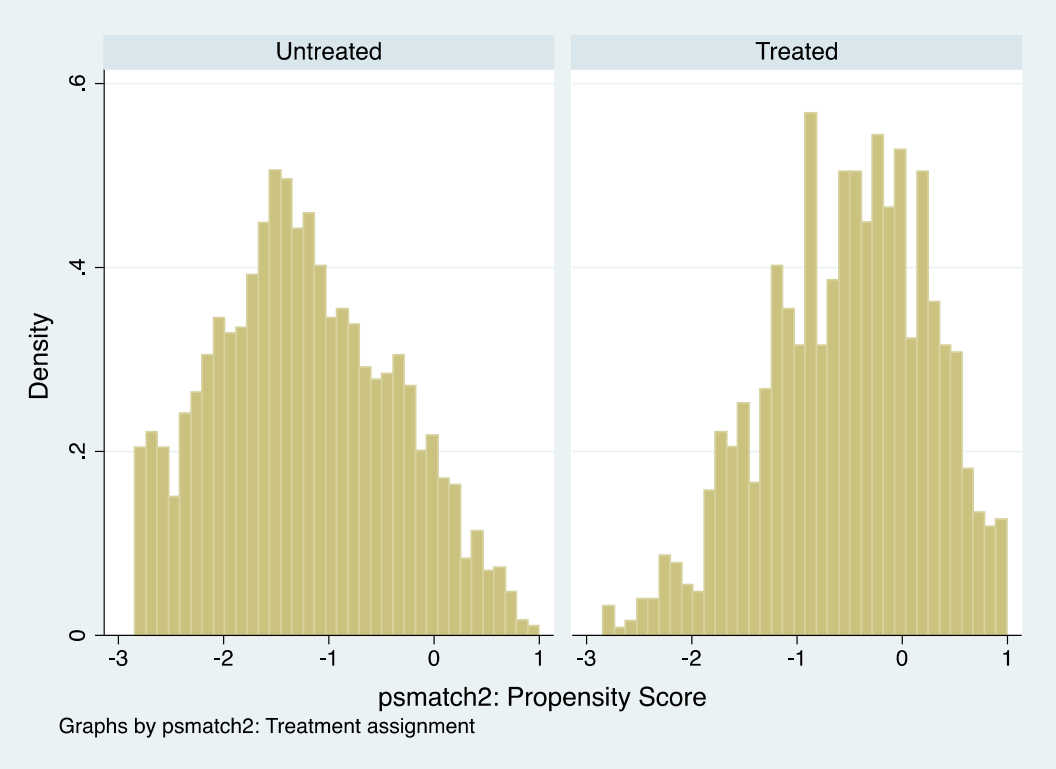
Child Food Insecurity



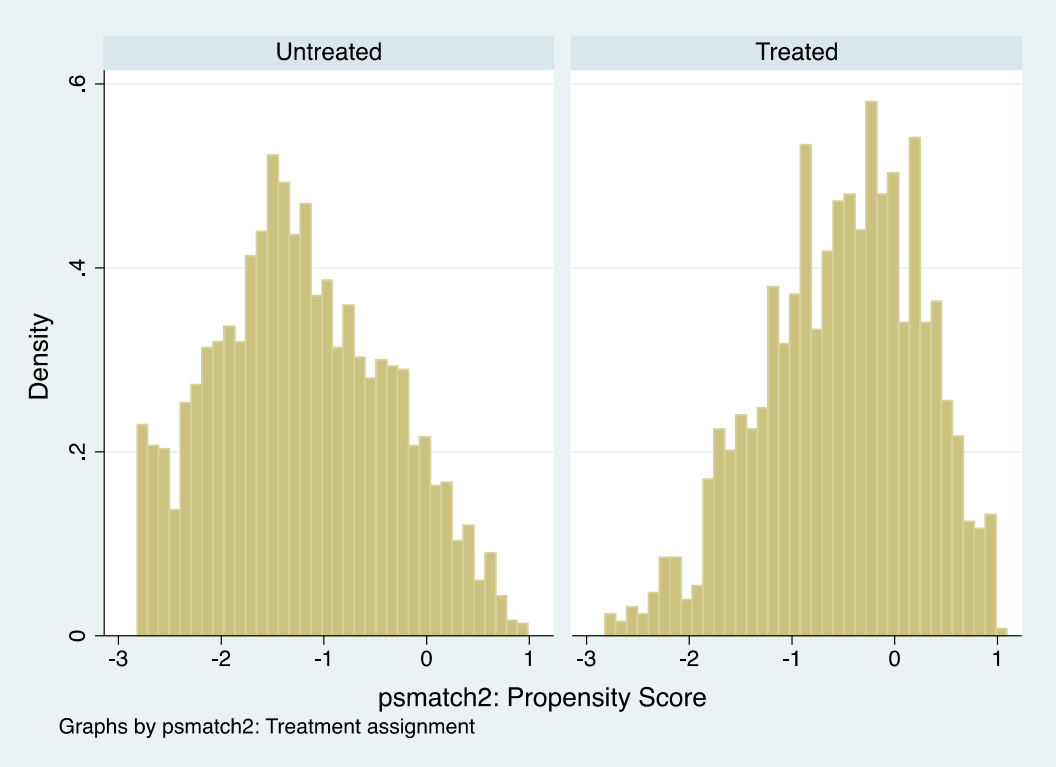
Adult Food Insecurity



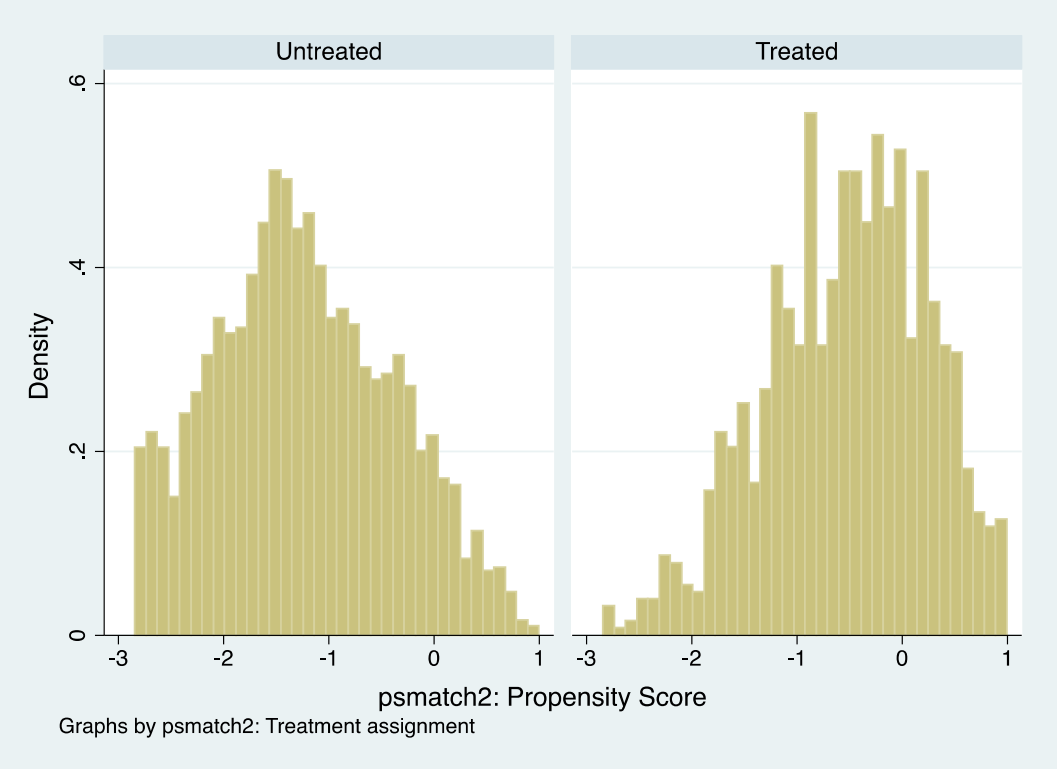
Household Very Low Food Security



Child Very Low Food Security



Adult Very Low Food Security


Untreated
Treated
Density
0
.2
.4
.6
-3
-2
-1
0
1
psmatch2: Propensity Score
Graphs by psmatch2: Treatment assignment

Appendix A-1: The Fragile Families and Child Well Being Study Core Food Security Questions

Variable name	Question	Responses	Classification as affirmative response
First Stage			
d1a	We worried whether food would run out before we got more money	1 = often true 2 = sometimes true 3 = never true	1 or 2
d1b	The food that we bought didn't last and we didn't have money for more	1 = often true 2 = sometimes true 3 = never true	1 or 2
d1c	We couldn't afford to eat balanced meals	1 = often true 2 = sometimes true 3 = never true	1 or 2
d1d	We relied on a few low-cost foods to feed the children	1 = often true 2 = sometimes true 3 = never true	1 or 2
d1e	We couldn't afford to feed the children a balanced meal	1 = often true 2 = sometimes true 3 = never true	1 or 2
1st Level Internal Screen			
Second Stage			
d3	The children were not eating enough because we just couldn't afford enough food	1 = often true 2 = sometimes true 3 = never true	1 or 2
d4	In the past 12 months did you cut the size of meals/skip meals because of not enough money for food?	0 = no 1 = yes	1
d4a	In the past 12 months, how often did adults cut size of/skipped meals because not enough money?	1=almost every month 2=some months but not every month 3=only 1 or two months	1 or 2
d5	In the past 12 months did you ever eat less than desired because there wasn't money for food?	0=no 1=yes	1
d6	In the past 12 months were you ever hungry, but not eat because you couldn't afford enough food?	0=no 1=yes	1
d7	In the past 12 months have	0=no	1

	you lost weight because there wasn't enough food?	1=yes	
2nd Level Internal Screen			
Third Stage			
d9	In the past 12 months did you/any adults ever not eat for a whole day because of a lack of money?	0=no 1=yes	1
d9a	How often did adults not eat for a whole day because not enough money?	1=almost every month 2=some months but not every month 3=only 1 or two months	1 or 2
d10	In the past 12 months did you ever cut the size of children's meals because of a lack of money	0=no 1=yes	1
d11	In the past 12 months did children ever skip a meal because of a lack of money?	0=no 1=yes	1
d11a	How often did children skip meals because lack of money?	1=almost every month 2=some months but not every month 3=only 1 or two months	1 or 2
d12	In the past 12 months were children ever hungry, but you couldn't afford more food?	0=no 1=yes	1
3rd Level Internal Screen (Uncommon)			
d13	In the past 12 months did children ever not eat for a whole day because there was not enough money?	0=no 1=yes	1

Households with **food insecurity among children** are defined by affirmative answers to two or more of the following questions: d1d, d1e, d3, d10, d11, d11a, d12, d13

Households with **very low food security among children** are defined by affirmative answers to five or more of the following questions: d1d, d1e, d3, d10, d11, d11a, d12, d13