DOES WIC IMPACT BREASTFEEDING BEHAVIOR?

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ABSTRACT

This analysis estimates whether participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) impacts breastfeeding behavior. Simple OLS regressions suggest that some relationship does exist between a number of breastfeeding behaviors and WIC participation as measured by redemption rates of WIC nutrition packages for infants. An instrumental variable for redemption rates is then constructed from the distance between an infant’s home and the nearest WIC vendor. The 2sls estimates using this instrument suggest a negative impact on the age at which formula is introduced and the likelihood of exclusive breastfeeding for one, three, or six months. The impacts of redemption rates on the duration and initiation of breastfeeding as estimated by the same model are not statistically significant.
I. INTRODUCTION

Launched in 1972, the Special Supplemental Program for Women, Infants, and Children (WIC) was designed to improve the health of low income pregnant mothers as well as their infants and children under the age of five. The program has grown from 88,000 participants in its first year to over 9.2 million in 2010 (“Nutrition Program Facts” 2015). In 2014 WIC cost over six billion dollars in federal and state taxes. Despite the program’s significant size and expense, WIC’s impact on infant health outcomes and maternal behaviors remains uncertain. This paper will help bridge that gap in knowledge by exploring the relationship between WIC participation and breastfeeding behavior.

The American Academy of Pediatrics recommends that infants are exclusively breastfed for the first six months of life. Breastfeeding is associated with lower risk for a variety of health problems including respiratory tract infections, gastrointestinal tract infections, allergies, celiac disease, inflammatory bowel disease, obesity, and neurodevelopmental issues (Ip, et al. 2007; Ip et al. 2009; Duijts et al. 2010; Quigley et al. 2007). The advantages of breastfeeding are amplified for preterm infants who are also at a higher risk for health issues (Vohr et al. 2006; Vohr et al. 2007; Shah et al. 2008; Hylander et al. 1998). Breastfeeding mothers also benefit, experiencing less postpartum blood loss, decreased likelihood of postpartum depression, and more rapid involution of the uterus as well as a variety of other health and economic benefits (Henderson et al. 2003).

Past evaluations have found that mothers who participate in WIC have a lower likelihood of participating in optimal breastfeeding behavior when compared to mothers who do not participate in WIC. The rate of initiation of breastfeeding for the total US population based on
the 2014 National Immunization Survey data is 75% while the initiation rate for mothers in the WIC program is 56% according to (Moore 2014). Among those who initiate breastfeeding, only a small fraction of WIC mothers exclusively breastfeed for the full six months recommended by the American Academy of Pediatrics. Some have suggested that this lack of exclusive breastfeeding among WIC participants could be the result of WIC participation itself (Pompkin, et al. 2981). By offering typically expensive formula for free, WIC could be inducing mothers to breastfeed less and introduce formula earlier than they would in the absence of WIC. To combat these incentives, the United States Department of Agriculture (USDA) introduced a number of measures such as breastfeeding counseling and classes to increase exclusive breastfeeding among WIC participants in the late 1990s. However, given the high financial value of the offered formula, these educational efforts may prove insufficient to significantly increase healthy breastfeeding behavior.

A confounding factor of past analyses of the potential relationship between the WIC program and its participants’ low breastfeeding rates is the demographic composition of WIC participants. Women who are most likely to be eligible and participate in WIC tend to have racial and socioeconomic characteristics that are also associated with lower breastfeeding rates. For instance, mothers who are black, low income, or poorly educated are much more likely to participate in WIC and also much less likely to breastfeed. This analysis has the advantage of only looking at women who already qualify and are registered for WIC and thus have an increased likelihood of these characteristics.

For this paper, I look at variation in WIC infant package redemption rates and breastfeeding behaviors among WIC participants in the Chicago area from 2010 to 2012. WIC
participants are issued a number of WIC credits that can be redeemed for certain food packages throughout a given time period. For a number of reasons, WIC participants often do not redeem all of the packages that they are offered. The number of packages redeemed per number of packages offered to a participant is that participant’s redemption rate. The first part of my analysis documents the relationship between redemption rates and breastfeeding and finds that increased redemption rates are associated with worse breastfeeding behaviors as quantified by a number of metrics. However, this simple OLS regression of breastfeeding behavior on redemption rates is likely tainted by endogeneity issues.

To ameliorate this concern, I construct an instrument for redemption rates from the distance an infant’s mother must travel to reach the nearest WIC vendor. I then use a two-stage-least-squares model with an instrumented redemption rate. With the instrument, I find that increased redemption rates are associated with a statistically significant decrease in the age at which formula is introduced and a reduction in the likelihood of exclusive breastfeeding. This suggests that WIC participation increases formula use, thereby reducing the quality of breastfeeding. On the other hand, while simple OLS regressions yield negative, statistically significant relationships between initiation and duration of breastfeeding, the 2sls estimates are not statistically significant.

II. BACKGROUND

A. WIC Program

The WIC program provides Federal grants to States for supplemental foods, health care referrals, and nutrition education for low-income pregnant, breastfeeding, and non-breastfeeding
postpartum women as well as infants and children up to age five who are found to be at nutritional risk. The program is administered by WIC state agencies, and benefits are distributed through agencies, authorized retailers, and clinics. A number of nonprofit agencies also help in the distribution of health services and food packages. To receive WIC benefits from a particular WIC state agency, participants must meet live within the jurisdiction, have an income less than 185 percent of the poverty level, and have been deemed to be at nutritional risk by a professional authority.

Once deemed eligible, a participant will receive different nutrition packages depending on a number of health factors. These health indicators are assessed in health clinic visits throughout an individual’s participation in WIC. A pregnant woman’s benefits will depend upon her health risk and breastfeeding status. Similarly, infants receive different nutritional packages depending on the amount of breast milk they receive. If an infant is breastfed, the infant is then further classified either as exclusively breastfed or as partially breastfed. Partially breastfed infants receive WIC nutrition packages containing formula to supplement what breastmilk they are provided. Infants who receive no breastmilk are classified as fully formula fed and receive nutrition packages with the largest amount of formula.

The sample used in this analysis is comprised of WIC participants in the Chicago area. In Illinois, participants receive a WIC debit card which can be used to redeem WIC food packages at a number of approved vendors, typically a grocery store or a nonprofit distributor. The debit card is periodically updated with new credit entitling the participant to more food packages.
B. Breastfeeding and WIC

Starting in the 1990’s, WIC programs instituted a number of efforts to encourage its mothers to breastfeed (”Breastfeeding: WIC's Efforts” 1993). Mothers are now offered different packages depending on their breastfeeding status. To compensate for the nutritional strain of breastfeeding as well as incentivize women to breastfeed, food packages offered to breastfeeding mothers are significantly larger than those offered to non-breastfeeding mothers. Furthermore, breastfeeding mothers are allowed to stay in the WIC program and receive food packages for up to a year after their child is born whereas non-breastfeeding mothers are ineligible after six months. In addition to these incentives, WIC also has instituted a number of educational programs to encourage breastfeeding. About 78 percent of local WIC agencies have at least one staff member with a certification in lactation counseling, consulting, education, or management and 89 percent collaborate with or extend outreach on breastfeeding promotion and support activities to hospitals, clinics, or doctors’ offices, including one-third that provide in-hospital breastfeeding support to WIC mothers (Forrestal 2014).

The effectiveness of these programs in increasing breastfeeding rates of WIC mothers remains nebulous. A 1998 study found that breastfeeding duration increased among mothers who visited WIC clinics that showed women educational breastfeeding videos and made peer counselors available (Gross, 1998). A similar study found that breastfeeding education and breast-pump loans increased the likelihood of breastfeeding initiation among Georgia mothers who received WIC (Ahluwalia et al., 2000). However, the decision to receive breastfeeding education or visit clinics where such resources are available is not entirely random. Mothers already inclined to breastfeed are likely to pursue breastfeeding counseling and education
services more than mothers who are resistant to breastfeeding. Furthermore, despite WIC’s efforts, the mothers who participate in WIC still breastfeed at significantly lower rates than the national average.

This disparity is likely partially due to demographic characteristics of the women who are most likely to be eligible and participate in WIC. Mothers with lower education, lower income, or of younger age are more likely to participate in WIC and also tend to breastfeed less (Noble, 2003; Tarkka 1999). Breastfeeding behaviour also varies by race. According to the Center for Disease Control, black mothers are almost 20 percentage points less likely to initiate breastfeeding than white mothers, and when they do so, black mothers tend to breastfeed for a shorter duration.

A few studies, have produced evidence that WIC participation itself may negatively impact breastfeeding behavior. After controlling for self-selection into the WIC program, Schwartz et al. (1995) find that WIC participation alone has a negative impact on breastfeeding initiation. Furthermore, a 2002 paper found that WIC participants are less likely to initiate breastfeeding than nonparticipants, but participation does not appear to affect breastfeeding for at least 16 weeks (Chatterji, et al.). Though both Schwartz and Chatterji produce suggestive evidence, their sample sizes, about 10,000 and 1,2000 respectively, are significantly smaller than that used in this analysis, about 68,000. Furthermore, these studies use data from the 1990’s when WIC had just launched many of their breastfeeding promotions. Indeed, breastfeeding among WIC participants has increased dramatically since the mid 1990’s (Kent, 2015). Thus, further research is warranted to determine the net impact of WIC participation on breastfeeding behavior today.
III. DATA

This analysis relies upon several separate datasets created by the Illinois Department of Human Services which administers the Illinois WIC program. The IDHS collects information regarding WIC package redemptions, participant demographics, and participant health information. Each participant has an identification number with which their redemption, demographic, and health information can be linked. The IDHS provides a dataset matching mother id’s to children id’s, thus allowing mothers to be linked with their children.

The participant dataset is comprised of the demographic information of the 324,000 mothers, infants, and children enrolled in the Chicago area WIC program. Variables included are age, race, ethnicity, income, home address, size of household and educational level. The summary statistics of the mothers in this sample are shown in the first two columns of Table 1. Also included in Table 1 are the summary statistics for nationwide WIC mothers. From this table, one can see that the mothers included in the sample of this analysis are demographically quite similar to other WIC mothers in age and educational attainment. However, WIC mothers in the IDHS sample tend to have a lower income than those in other parts of the nation. Because family-size-adjusted income eligibility requirements are relatively standard nationwide, this disparity likely reflects differences in the number of people in sample households compared to WIC households elsewhere. This analysis’s sample also has a larger percentage of black participants than the nationwide averages. Thus, though the WIC mothers in this sample are comparable to WIC mothers nationwide, there are a number of differences that will limit the external validity of this analysis.
In addition to demographic variables, this participant dataset also provides the address of the participant. This address can then be used to calculate the distance between the participant and the nearest WIC vendor. The range of the minimum distance travelled by participants is shown in Figure 1. Over 75% of participants live within a mile of WIC vendor. This metric will prove useful in the instrumental variables portion of this analysis. With the participant’s address, I am also able to match a number of variables from the Community Population Survey to characterize the demographic composition of the zip code in which each participant resides.

Health and breastfeeding information was gathered for each child over the course of several health clinic visits after the child’s birth through their 5th birthday. These health visits are the source of breastfeeding information for each child. During the visit, mothers were asked whether the child had ever been breastfed, the duration of said breastfeeding, whether the child had been introduced to formula, and if so, the date of said introduction. The summary statistics of these breastfeeding outcomes are shown in Table 2. The range and frequency of breastfeeding durations under a year can be seen in Figure 2. About 63% of infants are breastfed and only half are breastfed longer than a month. Though 40% of the sample’s infants are reported to receive some breast milk through their sixth month, only about 1% are breastfed exclusively for the six months recommended by the American Academy of Pediatrics.

The package redemption set is comprised of all WIC packages offered to WIC participants from May 2010 to May 2012. This set includes variables to indicate the participant to whom the package was issued, the type of foods it provides, whether it was redeemed, and if redeemed, the location and type of the store where it was redeemed. From this set, I am able to create the redemption rates of individual WIC participants. The range and frequency of
redemption rates is shown in the histogram Figure 3. Infant WIC participants redeem an average of 73.4% of the nutrition packages for which they are eligible, however, there is considerable variation in redemption rates. For instance, 17% of infants do not redeem any of the nutrition packages for which they are eligible while 30% of infants redeem virtually all of their nutritional packages.

Because this analysis focuses on how redemption rates impact breastfeeding behavior, I keep only infants who were born within the period of time for which I have redemption information, May 2010 to May 2012. With this restriction, I am able to match nearly 68,000 infants with to their demographic, redemption, and health information as well as their mother’s demographic information. This sample size exceeds those used by the two papers most similar to this analysis, the previously mentioned 1995 paper by J.B. Schwartz and 2002 paper by Pinka Chatterji.

These datasets are subject to a number of limitations. The participant’s address is recorded in the dataset only once when the individual is first enrolled in the WIC program. Thus, the variable I have generated measuring the minimum distance an individual must travel to redeem their WIC benefits could be inaccurate if the individual has moved since first enrolling in the program. Furthermore, because almost 70% of the health clinic visits took place over a year after their infant was born, the breastfeeding behaviors reported by the mothers at these visits are likely to have some degree of measurement error. Although a mother will probably remember whether or not her infant was breastfed at all, she may not know the exact date at which the breastfeeding ended. Given the high priority WIC health clinics put on breastfeeding, a mother who has difficulty remembering her breastfeeding behavior may also be tempted to overstate the
duration or exclusivity of her breastfeeding. To mitigate these issues, I drop outliers from the sample of this analysis. For instance, individuals whose breastfeeding duration is in excess of a year, which coincides with approximately the 90th percentile, are dropped from the sample.

III. APPROACH

This analysis seeks to estimate the relationship between an infant’s WIC nutrition package redemption rate and the level of breastfeeding received by that infant. The basic OLS model of the relationship between redemption rates and breastfeeding outcomes is as follows:

\[ BF_i = \beta_0 + \beta_1 R_i + \beta_2 X_j + \beta_3 Z_{ij} + \epsilon_{ij} \]

This equation is specific to an individual infant (i) with mother (j). \( R_i \) is the rate of packages redeemed out of all those offered to an individual infant. \( X_j \) is a vector of a number of the mother’s demographic characteristics including income, race, education, and age. \( Z_{ij} \) is a vector of the characteristics of the zip codes in which the infant and mother live; virtually all infants lived in the same zip code, if not the same household as the mother. Unfortunately, a given infant’s redemption rate is likely to be endogenous. WIC Mothers who have already decided not to exclusively breastfeed will naturally also decide to redeem more formula for their infants. Thus, the correlation between redemption rates \( R_i \) and the error term, \( \epsilon_{ij} \), is unlikely to be equal to zero. The above model could thus produce biased estimates that likely overstate the impact of redemption rates on breastfeeding behavior by also including the reverse causation effect of the mother’s breastfeeding behavior on redemption behavior.
To combat this issue, I use an instrumental variable: the distance from an infant’s home to the nearest WIC store. The first stage will show that this distance variable is correlated with redemption rates. It is specified as follows:

\[
(2) \quad \hat{R}_i = \beta_0 + \beta_1 D_i + \beta_2 X_i + \beta_3 X_j + \beta_4 N_{ij} + \epsilon_{ij}
\]

\(D_i\) is the distance from the infant’s home to the nearest WIC store.

Aside from its influence on redemption rates, the distance from a WIC vendor is unlikely to be correlated with breastfeeding behavior. Thus, the minimum distance variable should prove a reasonable source of exogenous variation in redemption rates. Equation (2) can then be substituted into equation (1) to produce the following:

\[
(3) \quad BF_i = \beta_0 + \beta_1 \hat{R}_i + \beta_2 X_j + \beta_3 Z_{ij} + \epsilon_{ij}
\]

By using the exogenous variation in redemption rates generated by the distance variable, this 2sls model can estimate the impact of changes in redemption rates without the taint of endogeneity.

IV. RESULTS

A. Baseline OLS Regressions

The OLS regression of breastfeeding characteristics on redemption rates are reported in Table 3. A single infant is an observation in these regressions and standard errors are clustered at the zip code level. Higher redemption rates appear to be associated with negative breastfeeding behaviors. Compared to an infant who does not redeem any WIC nutritional packages, an infant who redeems all of its issued WIC nutritional packages will on average have a 8.61 percentage point decrease in the likelihood to be breastfed at all corresponding to a 13.5% decrease in initiation. Increasing an infant’s redemption rate from 0 to 100% is also associated
with a month or 46% decrease in breastfeeding duration and about a week earlier formula introduction. Increasing redemption rates is also associated with a decreased duration of exclusive breastfeeding. All of these estimates are statistically significant at the 5% level and are rather large in magnitude.

A number of covariates are also statistically significant. Black mothers tend to initiate breastfeeding at lower rates and have a shorter duration of breastfeeding than white mothers. When other socioeconomic covariates are included such as income and education, the age of the mother does not appear to have a statistically significant impact on most breastfeeding outcomes with the exception of the duration of breastfeeding. Mothers of lower education tend to also demonstrate worse breastfeeding habits. These results are largely consistent with earlier research.

B. First Stage

The first stage of the two-stage-least squares model regresses the infant’s redemption rates on the distance from the infant’s home to the closest WIC vendor in order to test the distance metric as an instrument. These results are reported in Table 4 and Figure 4. As the minimum distance an individual must travel to reach a WIC vendor increases, redemption rates for infants falls. This effect remains significant at the 95% confidence level, even when individual and zip code level controls are added. The effect is largest in magnitude when restricted to smaller distances. For those who live less than three miles away from a vendor, redemption rates decrease by an average of 2 percentage points for every mile farther an individual lives from a vendor.
C. Second Stage

For the second stage of the 2sls, the sample is restricted to those within three miles of a WIC store. The results of this stage are reported in Table 5. For those who are within three miles of a WIC vendor, increased redemption rates are associated with a twenty percentage point decrease in the likelihood of breastfeeding and a 214 day increase in breastfeeding duration. Neither initiation nor duration outcomes, however, are statistically significant for this stage.

I do find that increased redemption rates are associated with a statistically significant reductions in the exclusivity of breastfeeding. An increase in redemption rates from 0 to 100% is associated with introducing formula 2.6 months earlier. Infants who redeem all of their coupons are 60 percentage points less likely to breastfeed exclusively at least one month, 32 percentage points less likely to breastfeed exclusively at least three months, and 23 percentage points less likely to breastfeed exclusively at least six months. All of these estimates are significant at the 5% level.

V. DISCUSSION

The baseline OLS regressions of breastfeeding behaviors on redemption rates suggest that there is some relationship between WIC participation and negative breastfeeding behaviors, including decreased likelihood of initiation, shorter duration, reduced exclusivity, and earlier introduction of formula. The 2sls specification supports baseline estimates for age of formula introduction and likelihood of exclusive breastfeeding at one, three, and six months. These
statistically significant results are strong evidence that WIC does have a large, negative impact on the exclusivity of breastfeeding.

Exclusive breastfeeding is a time consuming task for many mothers. For the first month of life, infants typically need to be breastfed from 8-12 times a day. These feedings can last from 20 to 45 minutes each. (“How Often to Breastfeed” 2015) Even for a mother who does not work outside the home, this is a considerable time commitment that can interfere in other responsibilities. There are other difficulties associated with exclusive breastfeeding. Many women experience physical discomfort including nipple soreness, plugged ducts, or exhaustion from frequent feedings. Mothers also cite worries of insufficient milk supply, sexuality issues, maternal smoking, contraception, negative self-image, and embarrassment from public breastfeeding as drawbacks to exclusive breastfeeding (McCann M. E., Baydar N., & Williams R. L., 2007).

Given the many challenges of exclusive breastfeeding, it is reasonable to expect that mothers would seek alternative sources of infant nutrition. The most popular alternative, infant formula, presents a significant expense to consumers. While breastfeeding poses no explicit financial cost, estimates find that the formula necessary for the first year of life costs over $1,700 to an average consumer purchasing at a store (Hamm 2013). This price could actually be significantly higher for the mothers in this sample, depending on where in the Chicago area they live (Block 2006). By providing free formula, WIC drastically lowers this cost, thus providing a strong incentive to introduce formula and cease exclusive breastfeeding earlier than they would otherwise.
While the 2sls regressions verify baseline results for formula introduction and exclusive breastfeeding, regressions in this specification produce no statistically significant estimate for the impact of WIC redemption rates on breastfeeding initiation. This indicates that the statistically significant baseline estimates were the result of the endogenous nature of redemption rates. The lack of evidence for a relationship between WIC redemption rates and breastfeeding initiation could have a number of explanations. As defined in this analysis, initiation of breastfeeding has a relatively low cost. In the IDHS dataset, a mother is considered to have initiated breastfeeding if she has attempted to breastfeed her infant at any point. Thus, mere initiation does not necessarily entail a significant investment or sacrifice on the part of the mother. This means that regardless of the availability of formula through WIC, a mother may at least attempt to breastfeed, even if she does not have a strong commitment to continue doing so.

The 2sls specification also produces estimates that suggest that WIC redemption rates have no statistically significant impact on breastfeeding duration. When interpreted with the earlier 2sls results, this suggests that with increased nutrition package redemption rates, the WIC mothers choose to merely supplement their breastfeeding with the provided formula instead of ceasing breastfeeding altogether. The lack of impact of redemption rates on breastfeeding duration is more difficult to explain than the lack of impact found on initiation. Although mere initiation of breastfeeding may only entail a small cost in terms of time and personal inconvenience, this cost is compounded over the duration of breastfeeding. Thus, one would expect that the availability of a free alternative to breastfeeding would have some diminishing effect on duration of breastfeeding.
If this negative incentive does indeed exist, the 2sls regressions suggest that increased redemption rates also has a positive effect on duration that cancels out the negative influence of WIC. A potential explanation for the lack of impact is that by supplementing the infant’s diet with formula, WIC decreases the number of times a child must be breastfed per day, thus reducing the strain of breastfeeding. This reduction in cost of an additional day of breastfeeding could in turn increase a mother’s willingness to breastfeed, thus combating the possible duration-shortening effect of formula. The availability of formula could have other positive impacts on breastfeeding. A 2013 study found that introducing formula shortly after birth can decrease mothers’ concerns regarding milk supply and thus encourage longer breastfeeding duration (Flaherman 2013). Most studies, however, show that earlier introductions of formula are generally associated with shorter breastfeeding durations (Declercq 2015; Murray et. al. 2007; ). Thus, further research is necessary to explore WIC’s impact on duration.

The WIC program’s breastfeeding promotion and education efforts are a final potential explanation for the lack of statistically significant impact of redemption rates on both breastfeeding initiation and duration. As mentioned previously, WIC’s breastfeeding promotion has been shown to have some positive impacts on breastfeeding behavior (Ahluwalia et al., 2000; Gross, 1998). If increased nutrition package redemption rates also leads to increased exposure to educational and counseling services, any potential negative influence of formula availability could be counteracted by the additional exposure to provided by WIC. Unfortunately, the IDHS data used in this analysis does not include the types and level of breastfeeding promotional services provided to each participant, thus this question cannot be tested at this time.
VI. CONCLUSION

This paper attempts to elucidate the impact of WIC nutrition package redemption rates on breastfeeding behaviors among WIC participants in the Chicago Area. Though this analysis benefits from a large sample size and access to several demographic controls, it is subject to a number of limitations. The self-reported breastfeeding behaviors used in this analysis are subject to measurement error. Furthermore, though mothers in this sample are somewhat similar to WIC mothers nationwide in age and educational attainment, they also differ in a number of characteristics such as income and race, reducing the external validity of this analysis.

Despite these limitations, this study does produce suggestive evidence that WIC negatively impacts breastfeeding behavior. I find that increased WIC redemption rates are associated with earlier formula introduction and decreased likelihoods of breastfeeding at one, three, and six months. These changes in breastfeeding behaviors are associated with a number of health concerns. Premature introduction of formula also presents significant expenses to the WIC program as a whole (Heinig, 1998; Hoey & Ware, 1997; Jarosz, 1993; Montgomery, 2997).

This is not necessarily mean that WIC should stop providing formula altogether. There are a number of circumstances in which a mother should not breastfeed her infant, such as when the mother has an infection, is suffering from certain medical conditions, or uses illicit drugs (Eidelman 2012). In the absence of WIC formula, some infants would potentially have to rely upon either tainted breast milk or some other substitute inferior to the supplied formula.

The WIC program thus has the difficult joint task of encouraging exclusive breastfeeding among mothers who are able to do so while also ensuring that infants of mothers who cannot
exclusively breastfeed receive sufficient formula. This study suggests that further efforts to promote exclusive breastfeeding among able mothers, either through educational programs, strict formula requirements, or other means is warranted. Additionally, though the baseline OLS regressions produce suggestive results, the potential relationship between redemption rates and breastfeeding initiation and duration remains nebulous after 2sls analysis, suggesting the need for further research regarding these outcomes.


Duijts, L., Jaddoe, VW, Hofman, A, Moll, HA. Prolonged and exclusive breastfeeding reduces the risk of infectious diseases in infancy. Pediatrics. 2010;126(1). Available at: <www.pediatrics.org/cgi/content/full/126/1/e18>


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Quigley MA, Kelly YJ, Sacker A. Breastfeeding and hospitalization for diarrheal and respiratory infection in the United Kingdom Millennium Cohort Study. Pediatrics. 2007;119(4). Available at: <www.pediatrics.org/cgi/content/full/119/4/e837>


effects of breast milk in the neonatal intensive care unit on the developmental outcome of extremely low birth weight infants at 18 months of age. Pediatrics. 2006;118(1). Available at: <www.pediatrics.org/cgi/content/full/118/1/e115>.

Table 1: The first two columns are the mean and standard deviation of Chicago WIC mothers who have given birth at some point from 2010 to 2012. Data on these mothers was provided by the IDHS and used in the regressions of this analysis. The other four columns are from the Community Population Survey in 2010 and show the mean and standard deviation of a number of demographic variables of mothers in the WIC program. No weights were used.

<table>
<thead>
<tr>
<th></th>
<th>Chicago WIC Mothers from Sample</th>
<th>Nationwide WIC Mothers from CPS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Age</td>
<td>26.52</td>
<td>6.24</td>
</tr>
<tr>
<td>Educational Attainment</td>
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<td></td>
</tr>
<tr>
<td>Less than highschool</td>
<td>35.82</td>
<td>43.24</td>
</tr>
<tr>
<td>high school</td>
<td>35.43</td>
<td>48.48</td>
</tr>
<tr>
<td>more than highschool</td>
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<td>42.48</td>
</tr>
<tr>
<td>Race</td>
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<td></td>
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<tr>
<td>white</td>
<td>42.63</td>
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<tr>
<td>black</td>
<td>28.53</td>
<td>45.116</td>
</tr>
<tr>
<td>asian</td>
<td>3.54</td>
<td>18.48</td>
</tr>
<tr>
<td>Hispanic</td>
<td>50.39</td>
<td>50</td>
</tr>
<tr>
<td>Income</td>
<td>12,911.82</td>
<td>8,921.78</td>
</tr>
<tr>
<td>Observations</td>
<td>N = 65,575</td>
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Table 2
Breastfeeding Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
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</thead>
<tbody>
<tr>
<td>Initiated Breastfeeding</td>
<td>63.7</td>
<td>48.09</td>
</tr>
<tr>
<td>Breastfed Exclusively</td>
<td></td>
<td></td>
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<tr>
<td>1 month</td>
<td>4.71</td>
<td>21.2</td>
</tr>
<tr>
<td>3 months</td>
<td>2.48</td>
<td>15.54</td>
</tr>
<tr>
<td>6 months</td>
<td>1.21</td>
<td>10.91</td>
</tr>
<tr>
<td>Breastfeeding duration in days</td>
<td>65.27</td>
<td>95</td>
</tr>
<tr>
<td>Age first formula (in months)</td>
<td>1.1</td>
<td>1.61</td>
</tr>
</tbody>
</table>

Table 2 Notes: Above are the mean and standard deviation of a number of breastfeeding outcomes of mothers from the IDHS dataset. The sample is restricted to mothers who live within three miles of a WIC vendor and who have given birth at some point between 20110 and 2012. A mother is considered to have initiated breastfeeding if she reports at any doctor visit that her infant has been breastfed. Breastfeeding duration is the day that mothers reported ceasing breastfeeding minus the infant’s birthday. Durations in excess of one year were dropped as implausible.
**Table 3 Notes:** Standard errors are clustered at the zip code level. Also included in the regressions are individual income and zip code level controls including percentage of black and hispanic individuals, percent of individuals below the poverty level, and average zip code income. An asterisk indicates that an estimate is statistically significant at the 5% level.
Table 4
First Stage Regressions

<table>
<thead>
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<th>Distance Restriction in miles</th>
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<th>&lt; 2</th>
<th>&lt; 1</th>
<th>&lt; 1/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant Redemption Rates</td>
<td>-1.96*</td>
<td>-2.18*</td>
<td>-4.37*</td>
<td>-4.44*</td>
</tr>
<tr>
<td></td>
<td>(0.41)</td>
<td>(0.48)</td>
<td>(0.76)</td>
<td>(1.74)</td>
</tr>
<tr>
<td>Number of Obs</td>
<td>67,905</td>
<td>64,948</td>
<td>52,795</td>
<td>29,200</td>
</tr>
</tbody>
</table>

Table 4 Notes: Also included in the regressions are the same set of controls used in Table 3. Standard errors are clustered at the zip code level. An asterisk indicates that an estimate is statistically significant at the 5% level.
Table 5: Redemption Rate indicates the synthetic Redemption Rate instrumented by the minimum distance to a WIC vendor. Standard errors are clustered at the zip code level. Also included in these regressions are individual income and zip code level controls including percentage of black and hispanic individuals, percent of individuals below the poverty level, and average zip code income. An asterisk indicates that an estimate is statistically significant at the 5% level.
Figure 1: Indicates the number of WIC infants who live at the indicated distance away from their nearest WIC vendor. Data comes from the IDHS dataset used in this analysis.

Figure 2: Indicates the number of WIC infants being breastfed for the indicated length of time in days. Data comes from the IDHS dataset used in this analysis. Durations over 365 days are dropped.
**Figure 3:** Indicates the number of WIC infants who redeem nutrition packages at indicated redemption rates. Data comes from the IDHS dataset used in this analysis.

**Figure 4:** Shows average redemption rates of individuals who live an indicated distance away from their nearest WIC vendor. Data comes from the IDHS dataset used in this analysis.