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WIC In Your Neighborhood: New Evidence on the Impacts of Geographic Access to Clinics

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WIC in Your Neighborhood:
New Evidence on the Impacts of Geographic Access to Clinics

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Abstract

A large body of evidence indicates that conditions *in-utero* and health at birth are predictive of individuals' long-run outcomes, pointing to the potential value in programs aimed at pregnant women and new mothers. This paper uses a novel identification strategy and data set to provide causal estimates of the effects of geographic access to the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the major US program aimed at improving the well-being of low-income pregnant and post-partum women, infants, and children under age 5. I utilize data on sibling births over 2005-2009 and administrative records on the locations and dates of openings and closings of WIC clinics over the same time period. The empirical approach uses within-zip-code variation in WIC clinic presence together with maternal fixed effects, and accounts for the potential endogeneity of mobility, gestational-age bias, and measurement error in gestation. The results show that geographic access to WIC clinics increases the likelihood of WIC food benefit take-up, and decreases the likelihood of gaining too little weight during pregnancy. I also provide some evidence that other aspects of the WIC program, such as health screenings and referrals to other services may have effects on women's behaviors during pregnancy. Finally, I show that access to WIC increases average birth weight and the likelihood of breastfeeding at the time of hospital discharge. The effects are strongest for mothers with a high school education or less, who are most likely eligible for WIC services.

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I. Introduction

A growing body of evidence suggests that *in-utero* conditions and health at birth matter for individuals' later-life well-being (Almond and Currie (2010, 2011)). The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is the major program in the United States that aims to improve the health and nutritional well-being of low-income pregnant and postpartum women and children under age five, and thus has potential to improve the life chances of the children who benefit from it. Program participants receive free nutritional food packages, as well as education about health, nutrition, and the benefits of breastfeeding. In recent years, there has also been a particular emphasis on the importance of coordination of WIC with other social programs and services. WIC clinics can thus serve as gateways for clients to receive other services, and WIC staff can make referrals to other agencies such as public prenatal care clinics, Medicaid, Food Stamps, housing services, and job banks, among others.

In 2011, Congress appropriated $6.7 billion to fund WIC, and the program serves approximately 2 million women and 7 million children per month.[1] Yet despite the continued growth of the program from its inception in 1974, the debate on the effectiveness of WIC has not been settled. This paper seeks to inform this debate in two ways. First, I analyze whether geographic access to WIC clinics affects WIC food benefit take-up, a question that has not been previously addressed. Then, I use a novel identification strategy that relies on within-zip-code variation in WIC clinic openings and closings in Texas over 2005-2009 and maternal fixed effects to provide estimates of the effects of access to WIC clinics on pregnancy behaviors, birth outcomes and breastfeeding.

While many studies have attempted to estimate the effects of WIC participation on infant health (e.g. Bitler and Currie (2005); Joyce, Gibson, and Colman (2005); Joyce, Racine, and Yunzal-Butler (2008); Figlio, Hammersma, and Roth (2009); Hoynes, Page, and Stevens (2011)), fewer have considered the determinants of WIC take-up. A large literature documents less-than-full take-up rates for public programs among eligible individuals (see Currie (2006) for a review), and the problem with pregnant women's WIC take-up is similarly substantial (Bitler, Currie, and Scholz (2003)). One hypothesis is that geographic access to WIC clinics may affect WIC participation. However, no past studies have rigorously tested this hypothesis. In fact, in a

[1] Information about the WIC program is available at http://www.fns.usda.gov/wic/WIC-Fact-Sheet.pdf.

recent review of the literature on WIC, Ludwig and Miller (2005) write that "…more evidence on what drives WIC participation would be extremely valuable for both research and policy." Past research does find that distance to social service agencies that administer the childcare subsidy process determines the likelihood of childcare subsidy take-up (Herbst and Tekin (2010)).[2] Further, evidence from psychology and behavioral economics suggests that proximity to program offices may be particularly salient for take-up because it can lead to more awareness of program existence, more frequent reminders to sign up, and reduced "hassle" costs (Bertrand, Mullainathan, and Shafir (2006)). It is therefore conceivable that geographic access to WIC clinics determines pregnant women's likelihoods of signing up for and receiving WIC benefits.

Additionally, whether WIC actually affects infant health and breastfeeding remains an open question. Many of the existing studies on WIC rely on comparisons between WIC participants and non-participants and likely suffer from omitted variables bias due to non-random selection into WIC participation. Recent work has attempted to deal with this issue by using more narrowly defined control groups (Bitler and Currie (2005); Joyce, Gibson, and Colman (2005); Joyce, Racine, and Yunzal-Butler (2008); Figlio, Hammersma, and Roth (2009)), employing propensity score matching methods (Gueorguieva, Morse, and Roth (2009)), including maternal fixed effects (Brien and Swann (2001); Chatterji *et al.* (2002); Kowaleski-Jones and Duncan (2002)), and using variation in state program parameters as instruments (Chatterji *et al.* (2002)). Yet the findings from these studies are mixed, arguably in part because they are still plagued by identification issues.[3] Studies that rely on narrowly defined control groups and propensity score matching may still suffer from bias due to selection on unobservable variables, while studies that include maternal fixed effects may be confounded by other time-varying within-family changes between sibling births. Additionally, variation in WIC parameters across states is not large, and thus these variables create poor instruments for WIC participation (Bitler and Currie (2005)).

Hoynes, Page and Stevens (2011) present a notable improvement upon the existing literature. They rely on county-year variation in the initial roll-out of the WIC program in the

[2] Past research has also considered distance to sites for health and educational services. For example, Kane and Rouse (1993) and Card (1995) use distance to the nearest college as an instrument for educational attainment, while Currie and Reagan (2003) estimate the impacts of distance to the nearest hospital on access to care.

[3] Estimates of the effect of WIC on the likelihood of low birth weight range from no effect for the whole sample (Joyce, Gibson, and Colman (2005)) to a 30% reduction (Bitler and Currie (2005)) to an over 100% reduction (Figlio, Hammersma, and Roth (2009)).

1970s for identification, and provide substantial evidence that program implementation was uncorrelated with other determinants of birth outcomes. They find that counties with WIC experienced modest improvements in birth weight. However, despite the important methodological contributions of this study to the literature, it is limited in three dimensions. First, the authors are unable to observe actual WIC participation or food receipt in their data, so their estimates represent reduced-form effects of the presence of WIC services in a given county on birth weight, and cannot address a crucial question of the extent to which having a WIC clinic in one's county of residence affects WIC benefit take-up. Second, the analysis relies on older birth records data which do not contain information on either breastfeeding or various pregnancy behaviors that may be affected by WIC. Third, the analysis presents estimates of the effects of WIC in the 1970s, when the program was first implemented and therefore operated on a much smaller scale than it does today. Understanding the causal effects of WIC in the current context, with its emphasis on coordination of social service programs, and especially during the time of the Great Recession, is critical for policy implications today.

This paper uses restricted data from the universe of Texas birth records over 2005-2009 together with administrative data on the locations and dates of openings and closings of all WIC clinics that operated in Texas over this time period. The births data contain information on mothers' full maiden names, exact dates of birth, states or countries of birth, and zip codes of residence, which allows me to link siblings born to the same mother and determine whether mothers had an operating WIC clinic in their zip codes of residence during their pregnancies. Additionally, unlike older birth records data, these data contain information on WIC food receipt during pregnancy, a wide range of pregnancy behaviors, as well as on breastfeeding at the time of hospital discharge. My analysis compares births by mothers who did and did not have a WIC clinic in their zip code of residence during pregnancy, and includes maternal fixed effects to control for all time-invariant characteristics of mothers that may be correlated with residential location, WIC participation, and birth outcomes. Empirical evidence demonstrating that within-zip-code variation in WIC clinic access is generally uncorrelated with changes in observable maternal characteristics reinforces the validity of the identification strategy. Importantly, unlike previous studies on WIC that use maternal fixed effects, my analysis relies on variation in WIC use stemming *only* from WIC clinic openings and closings, rather than from other factors that may affect a woman's decision to receive WIC benefits during one pregnancy and not during another.

One important time-varying characteristic of the mother is her residential location during pregnancy. A mother's decision to move between pregnancies may be correlated with determinants of WIC clinic openings and closings (for example, unemployment shocks may lead to increased mobility following job loss and greater demand for WIC services), and thus confound estimates from a maternal fixed effects model. The use of maternal fixed effects may also exacerbate biases due to measurement error. Another issue that has been pointed out by other researchers (e.g., Joyce, Gibson, and Colman (2005); Ludwig and Miller (2005); Joyce, Racine, and Yunzal-Butler (2008)) is that longer gestation periods are mechanically correlated with a higher likelihood of WIC use. Women with longer pregnancies have more time to receive WIC services, and are also more likely to experience either an opening or a closing of a WIC clinic during their pregnancy. In the above design, this mechanical correlation may lead to biased estimates of the effects of WIC. In particular, since women with longer pregnancies are more likely to experience a clinic opening, we should expect a positive correlation between WIC clinic presence and gestation. Since gestation is correlated with other birth outcomes such as birth weight, the estimates of access to WIC on infant health will be biased upward as a result of this issue.

To account for the potential endogeneity of maternal residence, measurement error, and the mechanical correlation between gestation and WIC, I implement a maternal fixed effects-instrumental variables strategy. My instrument is an indicator for whether the mother would have had an open WIC clinic during the current pregnancy *assuming she continued to live in the first zip code in which I observe her, and assuming her pregnancy lasted 39 weeks*. Since the first zip code is a fixed characteristic of the mother, the first zip code itself does not have an independent effect on WIC use or birth outcomes in models that include maternal fixed effects. This instrument is highly correlated with whether the mother had an open WIC clinic during the actual gestation length of her current pregnancy and in her actual zip code of residence, but should have no independent effect on prenatal WIC food benefit receipt, other pregnancy behaviors, birth outcomes, or breastfeeding.

My results suggest that geographic access to WIC is fairly important. The presence of a WIC clinic in a mother's zip code of residence during pregnancy increases her likelihood of WIC food receipt by about 6 percent at the sample mean. The magnitude of the effect is higher for mothers with a high school education or less and mothers whose first births were paid by Medicaid, who are most likely to be eligible for WIC. Additionally, I find that the effect on WIC food benefit take-up is concentrated among mothers in urban areas, where distances to WIC clinics are relatively short. This suggests that proximity to WIC clinics affects take-up through dimensions other than travel cost savings – for example, women with WIC clinics in their (urban) zip codes may be more likely to physically see them on a regular basis and thus become aware of the program and be reminded to sign up.

I also find that WIC clinic access reduces the likelihood of gaining too little weight during pregnancy (defined as less than 16 lbs). In terms of birth outcomes, I find that WIC clinic presence is associated with a 27 gram increase in average birth weight (a 0.8 percent increase at the sample mean). The magnitude of this estimate is in line with the recent literature on WIC (e.g. Hoynes, Page, and Stevens (2011)). For mothers with a high school degree or less, I further document a positive effect on breastfeeding – the likelihood that a child is being breastfed at the time of discharge from the hospital increases by about 6 percent. This result is a novel estimate of the causal effect of WIC on breastfeeding, as most of the recent studies have not had this outcome available in their data (e.g. Hoynes, Page, and Stevens (2011); Figlio, Hammersma, and Roth (2009)). Importantly, I find no placebo effects of having an open WIC clinic either 3-6 months or 6-9 months following childbirth or before conception (and no open WIC clinic during pregnancy), which yields further support for my identification strategy.

Note that while I show that WIC clinic presence is a determinant of WIC food receipt, WIC clinics may affect birth outcomes and breastfeeding through other channels, such as through the educational component and through referrals to other social services. In fact, I find some evidence that suggests that aspects of WIC clinics other than the food benefits matter. For instance, there are positive effects on the likelihoods of less-educated women reporting that they have diabetes or hypertension during pregnancy, which are likely driven by higher diagnosis rates of such conditions at WIC clinics or through referrals from WIC. Additionally, I provide suggestive evidence that WIC clinic access increases Medicaid coverage and receipt of prenatal care from public clinics, which also likely operate through the referral channel.

Consequently, my estimates represent the overall effects of geographic access to WIC clinics on WIC food receipt, pregnancy behaviors, birth outcomes, and breastfeeding, but cannot solely identify the causal effects of receiving WIC food benefits on infant health. However, these estimates are arguably more policy-relevant as they can help inform the debate on the costs and benefits of operating WIC clinics in the current policy context.

This paper proceeds as follows. I discuss the WIC program and the related literature in more detail in Section II, and provide information on the data and sample in Section III. Section IV presents the empirical methods, while Section V discusses the results and some robustness checks. Section VI concludes.

II. Background

The WIC program was first established as a pilot program in 1972, implemented in 1974, and then permanently expanded to most US counties by the end of the 1970s (Hoynes, Page, and Stevens (2011)). The goal of the program is to improve the health and nutritional well-being of low-income pregnant and post-partum women, infants, and young children by providing them with nutritious food packages and health education. In Texas, as well as in other states, eligibility rules require participants to live in households with incomes below 185% of the poverty line and to be "at nutritional risk".[4] Participating pregnant and post-partum women, as well as parents and guardians of children under age 5, receive monthly benefits from WIC that can be taken to grocery stores and used to buy nutritious foods. WIC foods include iron-fortified infant formula and infant cereal, iron-fortified adult cereal, vitamin C–rich fruit and vegetable juice, milk, eggs, cheese, beans, and peanut butter.

For pregnant and post-partum women, another important component of WIC is education about nutrition, health, and breastfeeding. In fact, according to the Texas Department of State Health Services website, "clients receive encouragement and instruction in breastfeeding. In many cases, breastfeeding women are provided breast pumps free of charge. WIC helps clients learn why breastfeeding is the best start for their baby, how to breastfeed while still working, Dad's role in supporting breastfeeding, tips for teens who breastfeed, how to pump and store

[4] In Texas, WIC clients receive an initial health and diet screening at a WIC clinic to determine nutritional risk. WIC uses two main categories of nutritional risk: (1) medically-based risks such as a history of poor pregnancy outcome, underweight status, or iron-deficiency anemia, and (2) diet-based risks such as poor eating habits that can lead to poor nutritional and health status. Clients will be counseled at WIC about these risks and the outcome influenced by nutrition education and nutritious foods provided by WIC. (Information from the Texas Department of State Health Services: http://www.dshs.state.tx.us/wichd/gi/eligible.shtm)

breastmilk, and much more."[5] The specific emphasis on the importance of breastfeeding provides motivation for rigorously evaluating the extent to which WIC affects breastfeeding rates of new mothers. This is particularly interesting given that WIC participants can also obtain free infant formula, so the effects of WIC on breastfeeding are *a priori* ambiguous. The existing literature on the relationship between WIC participation and breastfeeding is limited to studies that rely on comparisons between participants and non-participants (e.g., Bitler and Currie (2005); Jacknowitz, Novillo, and Tieben (2007)), and on methods using maternal fixed effects and variation in state program parameters as instruments (Chatterji *et al.* (2002)). These studies find mixed results on the association between WIC use and breastfeeding, and likely suffer from omitted variables bias and problems due to weak instruments.[6] More recent studies that use more rigorous identification methods do not have data on breastfeeding, and thus cannot address this question (Figlio, Hammersma, and Roth (2009); Hoynes, Page, and Stevens (2011)). This paper attempts to fill this gap by using recent data with breastfeeding information together with an identification strategy that can arguably isolate the effects of WIC from other determinants of breastfeeding.

Another important component of WIC in more recent years has been the coordination with other social services. The promotion of coordination efforts stems from the national level. For example, in 2000, the U.S. Department of Agriculture distributed a handbook to all WIC state and local agencies that outlines twelve "model coordination sites".[7] In Texas, WIC clinic staff are instructed to provide referrals for clients to a number of other agencies including Medicaid, Food Stamps, Temporary Assistance for Needy Families (TANF), prenatal care clinics, literacy services, job banks, housing services, and drug and alcohol abuse programs, among others. Thus, WIC clinics can serve as gateways for low-income women and children to receive other social services. As a result, access to a WIC clinic may have impacts on their health and well-being through other channels than just WIC food receipt. This issue has not been

[5] See http://www.dshs.state.tx.us/wichd/gi/eligible.shtm for more information.

[6] Bitler and Currie (2005) find a positive relationship between WIC and breastfeeding, while Jacknowitz, Novillo, and Tieben (2007) and Chatterji *et al.* (2002) find a negative association. Bitler and Currie (2005) also show that variation in WIC program characteristics across states makes for poor instruments for WIC participation because of the low explanatory power of these variables.

[7] See http://www.fns.usda.gov/wic/resources/strategies.htm for more information.

explicitly addressed in much of the previous literature.[8] This paper seeks to shed light on some mechanisms through which WIC may affect infant health by studying the effects of WIC clinic access on various pregnancy conditions and behaviors.

In Texas, geographic access to WIC clinics is likely important because clients must apply for WIC in person. Prospective clients must schedule an appointment at a WIC clinic, and are required to bring documentation of their household income and Texas residence to the appointment.[9] During the appointment, applicants undergo a health screening, and receive education and counseling, as well as referrals to other agencies as applicable. At the end of the appointment, WIC eligibility is determined, and food benefits are provided to those who are eligible. Thus, it seems that, especially for low-income women who are likely to be time- and transportation-constrained, living in proximity of a WIC clinic may be particularly advantageous.

Further, a growing literature in behavioral economics can speak to the importance of contextual factors in people's decision-making processes. Bertrand, Mullainathan, and Shafir (2006) provide an overview of this literature and relate it to anti-poverty programs. They argue that small situational changes can have significant impacts on people's behaviors – for example, in a well-known experiment by Leventhal, Singer, and Jones (1965), participants who received education about the risks of tetanus were much more likely to actually get a tetanus shot if they also were given a map with the infirmary circled and urged to decide on particular time and route to get there. With regards to welfare programs, Bertrand, Mullainathan, and Shafir (2006) focus on three factors that can serve as considerable barriers to take-up: lack of knowledge about the program, hassle costs (such as tedious and complicated application forms or long wait times at program offices), and procrastination. In the context of WIC, all of these factors may be affected by zip-code-level access to clinics. First, living in proximity of a WIC clinic likely increases the likelihood that a woman will see it on a regular basis, thus informing her of the existence of the program. Second, proximity to a clinic may reduce hassle costs if women can more easily stop by either on the way to or from work, for example. Third, physically seeing a WIC clinic on a regular basis may serve as a reminder to sign up for services and combat procrastination.

[8] An important exception is the study by Bitler and Currie (2005), which estimates the effects of WIC participation on prenatal care initiation. However, their analysis relies on comparing WIC participants to other mothers on Medicaid, and thus may be affected by omitted variables bias.
[9] WIC clients must be Texas residents. U.S. citizenship is *not* a requirement for WIC eligibility.

My analysis uses variation in WIC clinic openings and closings to provide some of the first evidence on how geographic access to WIC clinics affects WIC food benefit receipt, pregnancy behaviors, birth outcomes, and breastfeeding rates. While the empirical literature on WIC dates back several decades, many studies are unable to overcome the challenge of non-random selection into WIC participation. Some of the earlier WIC studies do find a positive association between WIC and birth weight, as well as favorable relationships with other health outcomes like the probability of an infant being small-for-gestational-age (e.g., Devaney (1992); Ahluwalia *et al.* (1992)). However, Besharov and Germanis (2001) argue that these studies generally do not account for non-random selection into WIC, and if this selection is positive, then the benefits of WIC are likely to be overstated. To address this criticism, some researchers have attempted to use control groups that are more comparable to WIC participants. For example, Bitler and Currie (2005) compare women who receive WIC to other women on Medicaid (who are also eligible for WIC), and find that WIC use is associated with more prenatal care, higher birth weight, lower rates of premature births, greater breastfeeding rates, and a lower likelihood of an infant being admitted to the Intensive Care Unit (ICU). They also show that selection into WIC tends to be negative, at least on observable characteristics, suggesting that other studies on WIC may be actually underestimating the program's benefits.

In contrast, in two studies, Theodore Joyce and co-authors argue that the effect of WIC is more subtle than previously found (Joyce, Gibson, and Colman (2005); Joyce, Racine, and Yunzal-Butler (2008)). Both studies also use narrower control groups to deal with potential selection bias, and carefully address the issue of gestational-age bias resulting from the positive correlation between WIC enrollment and pregnancy length. They argue that the correlation between WIC and prematurity is spurious and driven by this gestational-age bias, but do find modest effects on fetal growth for some samples.

Two most recent studies on WIC have introduced novel identification strategies to account for the possibility of omitted variables bias in comparisons between WIC participants and non-participants, even in narrowly defined groups. Figlio, Hammersma, and Roth (2009) use data in which they can link Florida children who are born over 1997-2001 to their older siblings who are enrolled in elementary school. Their identification comes from the fact that the household income eligibility threshold for reduced-price lunches through the National School Lunch Program is the same as for WIC, at 185% of the poverty line. Their analysis compares outcomes of infants whose older siblings received reduced-price lunches in the same year to those of infants whose older siblings did not but received them in either the previous or following years. Their IV estimates suggest that while there is no effect of WIC on average birth weight, the likelihood of low birth weight is decreased by over 100 percent at the sample mean. However, a concern of omitted variables bias remains. In particular, it is impossible to separate out the effects of WIC from the effects of other factors (such as parental employment changes, for example) that are correlated with changes to the control families' eligibility status from year to year.

As discussed above, Hoynes, Page and Stevens (2011) rely on county-year variation in initial WIC program roll-out in the 1970s for identification. The methods presented here are most similar to their study since they also hinge on variation in geographic access to WIC. This paper builds on the work of Hoynes, Page, and Stevens (2011) by using finer variation in WIC clinic access within zip codes rather than counties, incorporating maternal fixed effects, and using an IV approach to address endogenous mobility and to account for the mechanical correlation between gestation length and WIC access. Further, this paper estimates the effects of WIC access on a wider range of outcomes including WIC food benefit receipt, pregnancy weight gain, pregnancy health conditions, Medicaid take-up, birth weight, and breastfeeding. Finally, estimates of access to WIC from a more current time period are arguably more valuable for policymaking purposes today.

III. Data and Sample

A. Data on WIC Clinics

My data on WIC clinic locations and opening and closing dates come from a public records request from the Texas Department of State Health Services. These data contain the names, addresses (including zip codes), and opening and closing dates for all WIC clinics in Texas that were either operating in 2010 or that were closed sometime over 1992-2010.[10] WIC

[10] Theoretically, the information on WIC clinic addresses should allow me to measure WIC clinic access using distances from mothers' homes rather than simply at the zip code level. However, street addresses are poorly recorded in the WIC clinic data. Geocoding these addresses introduced substantial measurement error, and hand checking a random sample of 50 WIC clinic addresses suggested that a large fraction of WIC clinic street addresses

clinic opening dates were not consistently reported in the 1990s, but have been much more reliably recorded over the last decade. For the purposes of my main analysis, I only use information on WIC clinic openings and closings over 2005-2009. I extend the time period to 2003-2010 for the placebo analysis, which relies on information on WIC clinics 6-9 months before conception or after childbirth, as discussed in Section V.

Figure 1 plots the number of operating WIC clinics by month in Texas from January 2005 to December 2009, the time period of my analysis. The number of WIC clinics has decreased from 614 clinics in January 2005 to 564 clinics in December 2009. In Texas, local WIC agencies have control over opening, closing, moving, and consolidating WIC clinics in their jurisdictions. These decisions are made for a variety of reasons, such as for space constraints (since many WIC clinics are operated at churches, community centers, and schools) and for cost-efficiency when multiple WIC clinics are located in proximity of one another. Additionally, WIC clinics may be closed when there is no longer a WIC approved grocery store operating in the area.[11] In recent work, Meckel (2012) shows that the introduction of the Electronic Benefit Transfer (EBT) system has induced many grocery stores to exit the WIC program by either shutting down or no longer accepting WIC food benefits. Consequently, it may be the case that the decline in WIC clinics over 2005-2009 is at least in part driven by the decline in WIC grocery stores over the same time period.

In my data, 578 Texas zip codes have had at least one open WIC clinic sometime over 2005-2009. Only 65 zip codes have ever had more than one WIC clinic operating in any given month, so the relevant measure of access for most women is an indicator for having at least one open WIC clinic in their zip code of residence. Over 2005-2009, 114 Texas zip codes experienced either a WIC clinic opening or a closing, providing substantial within-zip-code variation in WIC clinic access. Figure 2 provides some indication of this variation by showing a histogram of the distribution of the 87 zip codes that have had a non-zero change in the number of operating WIC clinics between January 2005 and December 2009. Note that this is an undercount of all zip codes that have had openings or closings since it just considers the difference in the number of WIC clinics between the first and last month in my data. Consistent

were incorrectly recorded. On the other hand, zip codes are generally reliably recorded and can be cleanly merged to the birth records data. Therefore, I rely on zip-code-level measures in my analysis.

[11] Information on the determinants of WIC clinic openings and closings comes from personal communication with Ellen Larkin, the WIC state program specialist at the Texas DSHS.

with evidence on the decline in the number of WIC clinics from Figure 1, most zip codes have had a one-clinic decrease over this time period.

B. Data on Births

I use restricted data from the universe of Texas birth records over 2005-2009, which are available through a special application process to the Texas Department of State Health Services. This data set contains 2,037,181 birth records. I limit the sample to singleton births with mothers who are Texas residents, with non-missing information on the child's date of birth, mother's date of birth, mother's full maiden name, mother's birth state or country, and mother's zip code of residence (N=1,937,003). The 8,431 births with missing gestation or gestation less than 26 weeks are also dropped.[12] I match siblings to the same mother using information on her full maiden name, exact date of birth, and birth state or country. The resulting sibling sample consists of 612,694 births.

The births data are matched to WIC clinic data by the mother's zip code of residence. WIC clinic access during pregnancy is calculated by first estimating the conception date from information on the child's birth date and gestation length and then creating an indicator variable equal to 1 if at least one WIC clinic was operating at any point during the pregnancy in the mother's zip code of residence, and 0 otherwise.[13] The instrument is calculated similarly, except that the relevant zip code considered is the zip code of the mother's *first* pregnancy residence and gestation is assumed to be 39 weeks for all births.

Table 1 presents some summary statistics from the births data. Nearly 56 percent of all mothers report receiving WIC food benefits at some point during their pregnancies. Most mothers are aged 25-34 at the time of childbirth and have a high school education or less. Fifty-nine percent of all mothers are married. Thirty-five percent of mothers are non-Hispanic white, 11 percent are black, while 51 percent are Hispanic. Average birth weight is around 3,300 grams, and 6 percent of births are low-birth-weight (<2,500g). Almost 75 percent of all mothers reported breastfeeding their infants at the time of discharge from the hospital.

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[12] This results in less than 0.5 percent of the sample being dropped, and these births generally have much worse outcomes than other births.

[13] Results using an indicator equal to 1 if a WIC clinic was operating during the entire pregnancy (rather than at any point during pregnancy) are similar. Results using a continuous variable that measures the fraction of time during pregnancy that a WIC clinic was open are also similar. These results are discussed in Section V.

When I split the sample by whether or not the mother ever had a WIC clinic in her zip code of residence during any pregnancy, or by whether she had one during the current pregnancy, some differences emerge. WIC food benefit receipt is substantially higher among mothers living in the same zip codes as open WIC clinics. These mothers also tend to be less educated, are less likely to be married, and more likely to be Hispanic rather than non-Hispanic white or black. They also tend to have children with somewhat lower birth weights and have lower breastfeeding rates. These differences suggest that WIC clinics tend to locate in relatively less advantaged neighborhoods, where perhaps their services are most needed. As a result, simple comparisons between WIC participants and non-participants or comparisons of areas with and without WIC clinics will likely yield downward-biased results because of this negative selection. These differences point to the importance of finding methods that can overcome such selection issues to estimate the true causal effects of access to WIC on infant health and breastfeeding.

IV. Empirical Methods

In an ideal research setting, one would conduct a randomized controlled trial to study the causal effects of WIC. One would randomly assign WIC access to women in a study population, and then compare the outcomes of the treatment and control groups.[14] However, absent such an experiment, researchers must develop identification strategies to overcome the issues resulting from non-random selection into WIC participation. In this study, I propose a novel identification strategy that relies on within-zip-code variation in WIC clinic openings and closings.

Without data on siblings, one could estimate the effects of access to WIC using the variation within zip codes. Specifically, one would use Ordinary Least Squares (OLS) to estimate an equation of the form:

[14] To my knowledge, only one study has conducted a randomized controlled trial to evaluate WIC. Metcoff *et al.* (1985) conducted a randomized study of WIC on 410 women in Oklahoma. Treatment women received WIC vouchers, while control women did not. They find that treatment group women had children with birth weights that were on average 91 grams higher than children of women in the control group. However, while these results are certainly supportive of a beneficial causal effect of WIC, external validity may be a problem due to the small, non-representative sample. Further, the study can only speak to the pure effects of WIC food receipt on birth weight in the 1980s, but cannot address the question of the effectiveness of other aspects of the WIC program, such as education and referrals, which are particularly prevalent today.

$$(1)\ Y_{iymzc} = \beta_0 + \beta_1 * WIC\_clinic_{iymz} + \theta' X_{iymzc} + \alpha_z + \gamma_y + \delta_m + \rho_c * t + \varepsilon_{iymzc}$$

for each child *i* born in year *y*, month *m*, with a mother residing in zip code *z*, and in county *c*. Y_{iymzc} is an outcome of interest such as an indicator for mother receiving WIC food benefits during pregnancy or birth weight. WIC_clinic_{iymz} is the key explanatory variable, which is equal to 1 if a WIC clinic was operating at any point during the time of the pregnancy in the mother's zip code of residence, and 0 otherwise. X_{iymzc} is a vector of maternal and child characteristics that includes indicators for mother's age (<20, 20-24, 25-34, 35-44, 45+), indicators for mother's race (non-Hispanic white, black, Hispanic, other), indicators for mother's education (less than high school, high school degree, some college, college or more), an indicator for the mother being married, and indicators for birth order. α_z are zip code fixed effects, γ_y are birth year fixed effects, δ_m are birth month fixed effects, while $\rho_c * t$ are county-specific linear time trends. ε_{iymzc} is a birth-specific error term. The key coefficient is β_1, which measures the effect of having an open WIC clinic in a mother's zip code of residence during her pregnancy on the outcome of interest.

Note that while zip codes with and without WIC clinics are likely different on a number of dimensions, time-invariant differences between them will be captured by zip code fixed effects. Additionally, county-specific linear time trends control for differences in linear trends in outcomes across counties. The identifying assumption for equation (1) is that the variation in WIC clinic openings and closings within zip codes is not correlated with other determinants of WIC participation or birth outcomes at the zip code level. This assumption may not be satisfied if common shocks lead to changes in the numbers of WIC clinics and also affect average zip-code-level birth outcomes. For example, if spells of foreclosures affect the characteristics of zip code populations, then they may change the demand for WIC services and also change average birth outcomes through selection effects and direct health effects.[15]

To address this issue, I take advantage of the data on sibling births, and estimate models that include maternal fixed effects. This is an improvement over a model with zip code fixed

[15] Currie and Tekin (2011) find that foreclosures have adverse effects on adult health. It is likely that pregnant women and infants would also experience such health effects.

effects, since I can then control for all time-invariant observed and unobserved maternal characteristics by comparing children borne by the same mother. Specifically, I estimate:

$$(2)\ Y_{ikymz} = \beta_0 + \beta_1 * WIC\_clinic_{iymz} + \theta' X_{ikym} + \alpha_k + \gamma_y + \delta_m + \varepsilon_{ikymz}$$

for each child *i*, borne by mother *k*, in year *y*, month *m*, with the mother residing in zip code *z* during pregnancy. Now, α_k are mother fixed effects, and the vector X_{ikym} only includes time-varying maternal and child characteristics: indicators for mother's age, mother's education, mother's marital status, and birth order.[16] The rest of the coefficients and variables are the same as before. Note that several past studies have used mother fixed effects methods to estimate the effects of WIC (e.g., Brien and Swann (2001); Chatterji *et al.* (2002); Kowaleski-Jones and Duncan (2002)). However, the difference in the design presented here is that the within-mother variation in WIC access is coming only from WIC clinic openings and closings, rather than from other (likely unobservable) factors that may influence whether a woman receives WIC services during one pregnancy and not during another.

In equation (2), the effect of WIC clinic access is identified using a sample of mothers who have at least one pregnancy in a zip code with an operating WIC clinic and at least one pregnancy in a zip code without a WIC clinic. These mothers are comprised of two groups: 1) mothers who always live in the same zip code but experience either a WIC clinic opening or closing between pregnancies, and 2) mothers who move zip codes between pregnancies and live in the same zip code as a WIC clinic during one pregnancy and not during another. However, the decision of whether to move or not may be correlated with other determinants of WIC clinic openings and closings, which could bias the estimates produced by equation (2). Additionally, fixed effects models may be biased towards zero in the presence of classical measurement error in the explanatory variable. The key explanatory variable in my analysis relies on information on gestational age to calculate exposure to a WIC clinic during the length of the pregnancy, and gestational age is likely to contain some measurement error.

[16] Note that for two-sibling families, a maternal fixed effects model is equivalent to a first-difference model, where maternal age is identified by the birth interval. I show below that in models with zip code fixed effects, WIC clinic access is uncorrelated with the number of births or with maternal age at childbirth. Consequently, it is reasonable to assume that maternal age is not endogenous, and can be included as a control.

A further issue with both models (1) and (2) is gestational-age bias (Joyce, Gibson, and Colman (2005); Ludwig and Miller (2005); Joyce, Racine, and Yunzal-Butler (2008)). In particular, women with longer gestation periods have more time to experience a WIC clinic opening or closing and to receive WIC services. Consequently, since women with longer pregnancies are more likely to experience a WIC clinic opening holding all else equal, we would expect to see a positive correlation between WIC clinic access and gestation, which in turn is correlated with better birth outcomes like higher birth weight. This would lead to an upward bias on the estimated effects of WIC access.

To address all of the above issues, I implement an instrumental variables – maternal fixed effects (IV-FE) approach. I consider the zip code in which I observe each mother during her *first* pregnancy. Then, for each subsequent pregnancy, I create a variable that is equal to 1 if a WIC clinic was operating at any point during the pregnancy in the mother's zip code *had she remained in her first zip code of residence and had her pregnancy lasted 39 weeks*. In other words, this instrument measures the mother's hypothetical WIC clinic access if she never moved and if all of her pregnancies lasted the same length of time. This hypothetical variable is used to instrument the WIC_clinic_{iymz}variable described above. Specifically, I estimate a second-stage equation of the form:

$$(3)\ Y_{ikymz} = \beta_0 + \beta_1 * \widehat{WIC\_clinic}_{iymz} + \theta' X_{ikym} + \alpha_k + \gamma_y + \delta_m + \varepsilon_{ikymz}$$

with the corresponding first-stage equation:

$$(4)\ WIC\_clinic_{iymz} = \pi_0 + \pi_1 * FST\_WIC\_clinic_{iymk} + \varphi' X_{ikym} + \rho_k + \sigma_y + \omega_m + e_{ikymz}$$

for each child *i*, borne by mother *k*, in year *y*, month *m*, with the mother residing in zip code *z* during pregnancy. Here, $FST\_WIC\_clinic_{iymk}$ is an indicator that is equal to 1 if a WIC clinic was operating at any point during the 39 weeks following conception in the mother's first-pregnancy zip code, and 0 otherwise. The other variables and coefficients are defined as before.

The idea behind this instrument is that although the mother's current pregnancy zip code is potentially endogenous, her first-pregnancy zip code of residence is controlled for by the inclusion of fixed effects. Consequently, identification comes only from variation in WIC clinic openings and closings in the mother's first-pregnancy zip code, which should be exogenous to any given mother. This instrument thus satisfies the conditions for being a valid instrument: it is highly predictive of WIC clinic presence in the mother's actual current zip code of residence and during the actual gestation length of the current pregnancy (since many mothers do not move and have gestations close to 39 weeks), but it should have no effect on the outcomes of interest except through its effect on true WIC clinic access.[17]

V. Results

A. Relationship Between WIC Clinic Access and Maternal Characteristics

My identification strategy relies on within-zip-code variation in WIC clinic access over time. A crucial concern with this approach is that omitted variables are correlated with both WIC clinic access and pregnancy and birth outcomes. While I cannot directly test for all potential omitted variables, I can assess the degree to which the variation in WIC clinic access across space and time is correlated with maternal characteristics. Table 2 presents results from estimating a variant of equation (1) with various maternal characteristics as dependent variables, controlling for birth year and birth month fixed effects, and with standard errors clustered on the zip code level. I estimate these regressions both with and without zip code fixed effects.

The results without zip code fixed effects in Panel A point to substantial differences across areas that do and do not have WIC clinics. In particular, WIC clinics tend to locate in zip codes that have more disadvantaged mothers – mothers who are less than 20 years old, have a high school education or less, are unmarried and are Hispanic. This is perhaps not surprising as these mothers are also most likely to be eligible for WIC services. However, these differences also point to the fact that simply comparing outcomes in areas with and without WIC clinics will likely lead to downward biased estimates of the effects of WIC access on birth outcomes because of the negative selection into WIC.

[17] Other studies that use a very similar IV-FE design include Almond, Currie, and Semionova (2011) and Currie and Rossin-Slater (2012).

Panel B of Table 2 suggests that zip code fixed effects do a fairly good job of controlling for these differences. These regressions now test whether within-zip-code changes in WIC clinic access are correlated with changes in maternal characteristics. Most of the coefficients become much smaller and statistically insignificant, suggesting that trends in WIC clinic openings and closings are generally uncorrelated with trends in maternal demographics. However, there is still some evidence of selection – WIC clinics tend to operate in zip codes when they have fewer college-educated mothers and more black mothers. Note that this selection would likely lead to a downward bias on the results, as less-educated and minority mothers tend to have worse pregnancy and birth outcomes. Consequently, one can argue that my estimates of the impacts of WIC clinic access on these outcomes represent lower bounds for the true effects. These results also point to the potential benefits of including maternal fixed effects to compare children borne by the *same* mother, rather than simply using the within-zip-code variation in WIC clinic access with average zip-code-level outcomes.

In Table 3, I examine the relationship between WIC clinic access and maternal mobility across zip codes. I estimate models of the form:

$$(5)\ Move_{ikymz} = \beta_0 + \beta_1 * WIC\_fstpreg_{iymk} + \pi * WIC\_fstpreg_{iymk} * X_{ikym} + \theta' X_{ikym} + \alpha_z + \gamma_y + \delta_m + \varepsilon_{ikymz}$$

for each child *i*, borne by mother *k*, in year *y*, month *m*, with the mother residing in zip code *z* during pregnancy. $Move_{ikymz}$ is an indicator that is equal to 1 if the mother moved zip codes between the current pregnancy and the first pregnancy, and 0 otherwise. $WIC\_fstpreg_{iymk}$ is an indicator that is equal to 1 if a WIC clinic was operating in the mother's zip code of residence during her first pregnancy, and 0 otherwise. I estimate this equation with and without first zip code of residence fixed effects, α_z. The vector of coefficients on the interaction terms, π, allows me to assess whether moving likelihoods differ across maternal characteristics.

The results in Table 3 demonstrate that older, more educated, and married mothers with fewer children are more likely to move zip codes if there was a WIC clinic in their first zip code of residence. These findings suggest that women's decisions to move (or not) between pregnancies may be correlated with the determinants of WIC clinic openings and closings. In particular, less advantaged women tend to remain in the same zip codes if they had a WIC clinic during their first pregnancy, perhaps because common shocks lead both to increases in demand for WIC services and to decreases in mobility among these women. Consequently, implementing an IV-FE strategy to address endogenous mobility is essential for estimating the true causal effects of WIC clinic access on WIC food benefit receipt, pregnancy behaviors, birth outcomes, and breastfeeding.

B. *WIC Clinic Access and Prenatal WIC Food Benefit Take-Up*

Having provided some evidence for the validity of my empirical approach, I turn to the analysis of the effect of WIC clinic access on WIC food benefit take-up. Figure 3 provides some graphical representation of the relationship between WIC clinic access and the take-up of WIC food benefits during pregnancy. This figure is created using data on all singleton births with mothers who reside in Texas (not just siblings). It plots the average prenatal WIC food receipt by the number of months between conception and the time of at least one WIC clinic operating in the mother's zip code of residence. For zip codes that experience a *first* WIC clinic opening over 2005-2009, the x-axis value is the difference between the conception year-month and the year-month of the first WIC clinic opening. For zip codes that experience a *last* WIC clinic closing over 2005-2009, the x-axis value is the difference between the year-month of the last WIC clinic closing and the conception year-month.[18] Consequently, conceptions plotted at positive values of the x-axis had at least one WIC clinic operating during the entire pregnancy duration. Conceptions plotted between the values of -9 and 0 on the x-axis experienced a WIC clinic opening or closing during pregnancy, and thus had at least one WIC clinic operating for part of the pregnancy duration. Conceptions plotted at values below -9 on the x-axis had no WIC clinic in the zip code of residence during pregnancy.

The figure suggests that prenatal WIC food benefit receipt tends to be higher when at least one WIC clinic is present in the mother's zip code of residence. The same pattern holds true in Figure 4, which limits the sample to sibling births, the main sample of my analysis. These figures suggest that there may be a relationship between geographical access to WIC and WIC benefit take-up, which I explore more rigorously using regression methods next.

[18] Zip codes that have experienced both a first WIC clinic opening and a last WIC clinic closing within a 38-month period – the time period displayed in the figure – are dropped (5 zip codes).

Table 4 presents the regression coefficients from estimating equations (1), (2), and (3) with an indicator for prenatal WIC food receipt as the outcome of interest. Appendix Table 1 shows the first stage and reduced-form results corresponding to the IV-FE estimate for the whole sibling sample. The first two columns of Table 4 use the universe of all singleton births in Texas, while all the other columns use only the sibling sample. Further, the seventh column considers mothers who had a high school education or less at the time of the first birth, and the eighth column limits the sample to mothers whose first births were paid by Medicaid. These two groups of mothers are most likely to be eligible for WIC services, and so we would expect to see bigger effects for them. All regressions include controls for mother's age, mother's education, mother's marital status, birth order, as well as birth year and birth month fixed effects. The regressions in the first four columns additionally include controls for maternal race and zip code fixed effects. The regressions in columns 2 and 4 also include county-specific linear time trends. The regressions in columns 5-8 include mother fixed effects. To account for serial correlation at the level of variation in the key explanatory variable, in columns 1-5, standard errors are clustered on the zip code level, while in all of the IV-FE specifications (columns 6-8), standard errors are clustered on the mother's first zip code of residence. Finally, to create consistent sample sizes across specifications within the sibling sample, for each outcome, births by mothers who have at most one child with non-missing data for that outcome are omitted.

The results suggest that having an operating WIC clinic in the mother's zip code of residence during any point of her pregnancy increases her likelihood of WIC food benefit receipt. The key coefficient of interest is positive and statistically significant across all specifications. According to the IV-FE estimate for the whole sibling sample, the magnitude of this effect is about 3 percentage points, corresponding to a 6 percent increase in WIC food benefit take-up at the sample mean. As expected, the coefficients are larger for mothers with a high school education or less and for mothers whose first births were paid by Medicaid. These results imply that geographic access to WIC clinics does matter, and seems to matter more for less advantaged women.

Appendix Table 2 presents additional results where the sample is split by urban versus rural zip codes.[19] The results suggest that geographic access to WIC clinics is more salient for

[19] Data on urban and rural classification of zip codes comes from the WWAMI Rural Health Research Center at the University of Washington. The data contain Rural-Urban Commuting Area (RUCA) codes that classify zip codes

mothers in urban areas than in rural areas. This finding is interesting since zip-code-level access to WIC clinics in rural areas presents greater travel distance savings than in urban areas. In fact, in urban zip codes, the average Texan woman with a WIC clinic in her zip code of residence must travel approximately 1.64 miles to the closest clinic, whereas the average woman without a WIC clinic in her zip code lives approximately 3.96 miles from the nearest clinic. On the other hand, in rural zip codes, women with WIC clinics in their zip codes travel an average of 2.12 miles, while women without WIC clinics in their zip codes travel an average of 9.18 miles to the nearest clinic.[20] Consequently, zip-code-level WIC clinic access represents decreases of 4.64 miles and 14.12 miles in round-trip travel distances for urban and rural mothers, respectively. However, it may be that in rural areas, women are more accustomed to driving far distances and thus are less responsive to changes in geographic access to services. In contrast, in urban zip codes, proximity to WIC clinics may matter more as women can potentially pass by and physically see WIC clinics during the course of their daily activities.

Indeed, my results suggest that despite the relatively small savings in travel times that arise from zip-code-level WIC clinic access, proximity to clinics is still important. Such a finding is supported by evidence from psychology and behavioral economics on the significance of contextual factors, and why seemingly minor situational changes may have large impacts (Bertrand, Mullainathan, and Shafir (2006)). For instance, physically seeing a WIC clinic on a regular basis may increase awareness of the program and serve as a needed reminder to sign up for services. Additionally, having a WIC clinic in very close proximity may reduce hassle costs, as women may be able to stop at a WIC clinic on their way to or from work, for example.

C. Effects on Pregnancy Behaviors

While receiving food benefits is an important aspect of the WIC program, access to a WIC clinic may affect mothers in several other ways. Women who come to a WIC clinic receive a health exam, which may increase the likelihood that they are diagnosed with various medical

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into urban and rural areas. I follow their guidelines to classify zip codes with the following codes as urban: 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, 10.1. All other zip codes are classified as rural. More information is available here: http://depts.washington.edu/uwruca/ruca-approx.php

[20] These estimates are calculated by computing the average of the distances between mothers' residence homes and the locations of the nearest WIC clinics. For WIC clinics with incorrectly recorded street addresses, I use the zip code centroid instead.

conditions such as hypertension or diabetes. They also receive information and education about nutrition and healthy behaviors. This may lead them to change their diet or exercise habits, or to stop smoking or drinking alcohol. Moreover, WIC clinics can serve as gateways to a range of other social services. For example, WIC staff can refer women to agencies that can help them enroll in other programs like Medicaid, Food Stamps, TANF, and housing assistance. They can also refer them to other services like counseling for substance abuse and job banks.

I test the extent to which some of these other mechanisms might matter in Table 5. This table shows the regression coefficients from the IV-FE model, with various pregnancy behaviors and conditions as dependent variables. The controls and fixed effects are the same as described above, with standard errors clustered on the mother's first zip code of residence. These results suggest that maternal weight gain is affected by WIC clinic access. In particular, women are 2 percentage points (12 percent at the sample mean) less likely to gain too little weight during pregnancy (defined as less than 16 lbs). The coefficient is larger in magnitude and more statistically significant for mothers with a high school education or less, who are likely at higher risk of malnutrition. Thus, the food benefits (and/or the nutrition education) seem to be important for these women and can prevent them from having an underweight pregnancy and putting themselves and their children at risk of various complications.

Interestingly, there is also a positive coefficient on the likelihood of the woman having gestational hypertension. This is likely a diagnosis effect, as women who show up at a WIC clinic are more likely to have this condition be identified. Similarly, for women with a high school education or less, there is a positive effect on diabetes. Note that there is no effect on the likelihood of experiencing eclampsia, a serious pregnancy condition that involves seizures and convulsions. Hypertension and diabetes are risk factors for eclampsia, and early diagnosis and treatment of these conditions may help prevent the onset of eclampsia. However, despite the increases in hypertension and diabetes diagnoses, I find no discernible effects on eclampsia. This is perhaps due to power issues that prevent me from detecting effects on low-frequency outcomes. It may also be that WIC clinic access only affects diagnoses of marginal (and therefore relatively mild) hypertension and diabetes cases, which are the least likely to develop into more serious conditions such as eclampsia.

My results also provide tentative evidence that WIC clinic access may have spillover effects on the take-up of other social programs. The coefficients for the likelihoods of receiving prenatal care from a public clinic and of the birth being covered by Medicaid are positive and large relative to the sample mean, and greater in magnitude for mothers with a high school education or less. However, the standard errors are too large to draw conclusive inference from these results, and they should therefore be interpreted as merely suggestive. Unfortunately, my data do not have information on participation in other programs such as Food Stamps or TANF, and thus I cannot determine whether WIC clinic access affects the take-up of those benefits.

There are also some pregnancy behaviors and conditions which do not seem to be impacted by WIC. I have estimated regressions for prenatal care adequacy and smoking during pregnancy, and found no statistically significant (or economically meaningful) results. The latter behavior is arguably expected to be most affected by the educational component of WIC, and my results suggest that this aspect of WIC may not have substantial influence on women's behavior during pregnancy.

D. *Effects on Birth Outcomes and Breastfeeding*

Having shown that WIC clinic access impacts pregnant women's food benefit take-up, weight gain, and diagnoses of some high-risk pregnancy conditions such as hypertension and diabetes, I next to turn to the analysis of the effects on birth outcomes and breastfeeding. The above results suggest that these outcomes may be affected by WIC clinic access through a number of different channels: in particular, there may be direct effects through food benefit take-up and indirect effects of having health exams and receiving other services through referrals from WIC.

Table 6 presents results from the IV-FE specification for five different outcomes: birth weight in grams, an indicator for low birth weight (<2500g), gestation in weeks, an indicator for a premature birth (<37 weeks gestation), and an indicator for the child being breastfed at the time of discharge from the hospital.[21] The results demonstrate that there is a positive effect of WIC clinic access on birth weight. Birth weight is increased by about 27 grams, a 0.8 percent increase

[21] I have also estimated effects on child gender at birth to assess the relationship between WIC access and the likelihood of fetal death, since male fetuses are more susceptible to fetal death (Almond and Edlund (2007)). However, I find no statistically significant effects of WIC clinic access on the likelihood that a child is male. This may be due to the fact that the highest fetal death rates occur during the early part of the pregnancy, by which time many women may not have had time to visit a WIC clinic. Unfortunately, my data have no information on *when* the WIC benefits were received during pregnancy, so I cannot study this issue directly.

at the sample mean. This magnitude is consistent with the most recent literature on WIC – for example, Hoynes, Page, and Stevens (2011) find an 18-29 gram increase in birth weight among participating mothers. Consistent with the results on WIC food benefit take-up and pregnancy conditions, the effect on birth weight is larger for less-educated mothers. For these mothers, there is also a marginally significant negative effect on the likelihood of a low-birth-weight birth. The lack of statistically significant effects on gestation and prematurity is also notable, especially in light of studies that argue that any relationship between WIC and gestation is spurious because of a lack of medical evidence supporting a protective effect of WIC on prematurity (Joyce, Gibson, and Colman (2005); Joyce, Racine, and Yunzal-Butler (2008)).

On the other hand, for mothers with a high school education or less, the effect on breastfeeding is statistically significant and positive – the likelihood of the infant being breastfed at the time of discharge is increased by about 6 percent at the sub-sample mean of 0.682. This effect implies that WIC emphasis on breastfeeding is relatively successful. However, an important limitation is that I cannot observe the duration of breastfeeding in my data. Therefore, while it may be the case that WIC encourages women to initiate breastfeeding, the provision of free formula may disincentivize breastfeeding in the long-run, as some past studies have shown (Jacknowitz, Novillo, and Tieben (2007); Chatterji *et al*. (2002)).

E. Additional Results and Robustness

The key identification assumption in the above analysis is that WIC clinic openings and closings in the mother's first zip code of residence are uncorrelated with other time-varying variables that may affect WIC food receipt, pregnancy behaviors, birth outcomes, and breastfeeding. One indirect test of this assumption is to check whether WIC clinic access either before the pregnancy or after childbirth is correlated with these outcomes. Since women have to be pregnant or post-partum to be eligible for WIC services, access to a WIC clinic before the start of the pregnancy should have no effect on the woman's pregnancy behaviors or her child's birth outcomes. Similarly, while women are eligible for WIC after giving birth, access to a WIC clinic after childbirth should have no effect on their behaviors during pregnancy or their children's outcomes at birth. However, if there is a correlation between WIC clinic openings and closings and maternal (unobservable) time-varying characteristics that affect these behaviors and outcomes, then we may detect some spurious placebo effects.

Table 7 presents the results from this placebo test. Here, the key explanatory variables are indicators for a WIC clinic operating in the mother's zip code of residence either 3-6 or 6-9 months before the start of the pregnancy or after childbirth, but no open WIC clinic during the actual pregnancy. Across all specifications, for all three main outcomes of interest (WIC food receipt, birth weight, and breastfeeding), and for both the whole sibling sample and the subsample of mothers with a high school education or less, none of the coefficients on these placebo variables is statistically significant at the 5 percent level. There are some marginally significant negative coefficients for birth weight and breastfeeding in some specifications, but they are opposite-signed than the coefficients on the main effects in Table 6. These findings are reassuring as they imply that trends in WIC clinic access are likely uncorrelated with other unobservable maternal time-varying characteristics, providing further support for the validity of the identification strategy used in this paper.

I next test whether my results are sensitive to the definition of WIC clinic access. In the main analysis, the key explanatory variable of interest is an indicator for a WIC clinic operating in the mother's zip code of residence at *any* time during her pregnancy. In Appendix Table 3, I estimate regressions using two alternative definitions: an indicator for a WIC clinic operating in the mother's zip code of residence for the *entire* duration of the pregnancy, and a continuous variable that ranges from 0 to 1 and denotes the fraction of pregnancy duration days that at least one WIC clinic was operating in the mother's zip code of residence. The results for WIC food benefit receipt using these alternative definitions are very similar to the main results presented in Table 2.[22] This is likely due to the fact that not many women experience a last WIC clinic closing or a first WIC clinic opening at some point during their pregnancies (rather than before or after), so these variables have equal values for most observations in the sample. It is nevertheless encouraging that the effects are consistent across several definitions of WIC clinic access.

I have also estimated heterogeneous effects of WIC clinic access by maternal race. In results not shown, I find that Hispanic mothers experience the largest increases in WIC food benefit take-up relative to non-Hispanic white and black mothers. However, Hispanics have the

[22] Results for other outcomes are also similar and available upon request.

smallest effects on birth weight out of the three groups. This may be because Hispanic mothers may be less likely to take advantage of other WIC services such as referrals to other agencies, if they have additional citizenship requirements, for example. However, sample size limitations prevent me from having the power to detect statistically significant differences across races, so these results are merely suggestive.[23]

Another important issue to address is whether WIC clinic access has an effect on the total number of births. In particular, if WIC has an effect on fetal deaths, then there could be a selection effect on birth outcomes as more "marginal" babies survive. Further, it is possible that WIC may incentivize women to become pregnant in order to receive the benefits. As a result, WIC access may affect the composition of births, which could bias the estimates on birth outcomes. I investigate this possibility in Table 8. I collapse the data into zip-code/birth-year/birth-month cells, and estimate regressions with the number of births and log number of births as dependent variables. I consider all singleton births, as well as all sibling births that are part of my main sample of analysis. All regressions include birth year, birth month, and zip code fixed effects, with standard errors clustered on the zip code level.

Across all specifications in Table 8, the results suggest that WIC clinic access is not correlated with the total number of births. This may be because the effect of WIC on fetal deaths is likely very small, since the highest fetal mortality rates occur in the early stages of the pregnancy, before many women have a chance to visit a WIC clinic. Further, these results suggest that WIC benefits do not have large incentive effects on conception. These findings are reassuring because they suggest that my main results are not driven by changes in the composition of births.

VI. Conclusion

Increasing support for the notion that fetal and infant health are predictive of individuals' later-life outcomes highlights the value of programs and policies aimed at pregnant women and new mothers. Indeed, successful programs that improve the welfare of disadvantaged women during pregnancy and post-partum may play an important role in ameliorating inequalities at

[23] These results are available upon request.

birth, and thereby potentially mitigating the intergenerational transmission of low socio-economic status. WIC is the major program in the United States whose goal is to enhance the health and nutrition of low-income pregnant and post-partum women, infants, and children under age 5. Consequently, rigorous evaluation of the program is necessary both for policy-making purposes and for providing new estimates of the determinants of fetal and infant health.

Although there are many studies that examine the relationship between WIC and birth outcomes, much less attention has been paid to the determinants of WIC benefit take-up. Moreover, consensus on the effectiveness of WIC has not been reached. Some of the existing literature on WIC may be affected by omitted variables bias due to non-random selection into WIC participation. Other studies suffer from lack of data on important variables such as WIC food benefit take-up and breastfeeding. Additionally, the mechanical correlation between gestation and WIC participation is not always carefully addressed. Finally, thorough evaluation of WIC in the current policy context, with the emphasis on coordination of services and during the time of the Great Recession, has not been done.

This paper uses restricted data on the universe of sibling births in Texas over 2005-2009 together with administrative data on all WIC clinic openings and closings during this time period to analyze the relationship between WIC clinic access, food benefit take-up, pregnancy behaviors, birth outcomes, and breastfeeding. My identification strategy relies on within-zip-code variation in WIC clinic openings and closings, together with mother fixed effects. Additionally, I use an instrumental variables technique to account for endogenous mobility between pregnancies, measurement error in gestation, and the mechanical correlation between gestation and WIC clinic access.

My results suggest that geographic access to WIC is a determinant of WIC food benefit take-up. Specifically, the presence of a WIC clinic in the mother's zip code of residence during pregnancy increases the likelihood that she receives food benefits by about 6 percent. The effects are driven by mothers in urban zip codes, where travel distance reductions from zip-code-level access are relatively low, implying that other contextual factors of proximity to clinics may be influential. Further, WIC clinic access decreases the likelihood that a woman gains too little weight during pregnancy, defined as fewer than 16 lbs. The effects on food benefit receipt and weight gain are larger in magnitude for mothers who have a high school education or less at the time of their first birth.

I also provide novel evidence on the importance of other aspects of the WIC program such as health screenings, education, and referrals to other social services and programs. I show that access to a WIC clinic increases the likelihood that a mother is recorded as having hypertension or diabetes, likely due to an increase in the likelihood of diagnosis of such conditions at a WIC clinic or through a referral. Further, I provide suggestive evidence that WIC clinics may serve as important gateways to other public benefit programs such as Medicaid and public prenatal care clinics for low-income pregnant women.

Finally, I find that for mothers with a high school education or less (who are most likely eligible for WIC services), WIC clinic access increases average birth weight, decreases the likelihood of a low-birth-weight birth, and increases the likelihood of the child being breastfed at the time of discharge. My results suggest that WIC is successful at improving health at birth for children of disadvantaged mothers, and that the effect may operate through multiple channels including food benefit take-up, health exams at clinics, and referrals to other agencies.

My results are robust across different specifications and alternative definitions of WIC clinic access. Further, I show that there are no placebo effects of WIC clinic presence either before conception or after childbirth. This suggests that my results are not driven by a correlation in trends between WIC clinic openings and closings and some unobserved time-varying maternal characteristics.

While this paper shows robust evidence on the effects of WIC clinic access on food benefit take-up, pregnancy behaviors, birth weight, and breastfeeding, my data do not allow me to follow children as they grow older. Understanding the long-run effects of WIC on children's outcomes should be the focus of future research.

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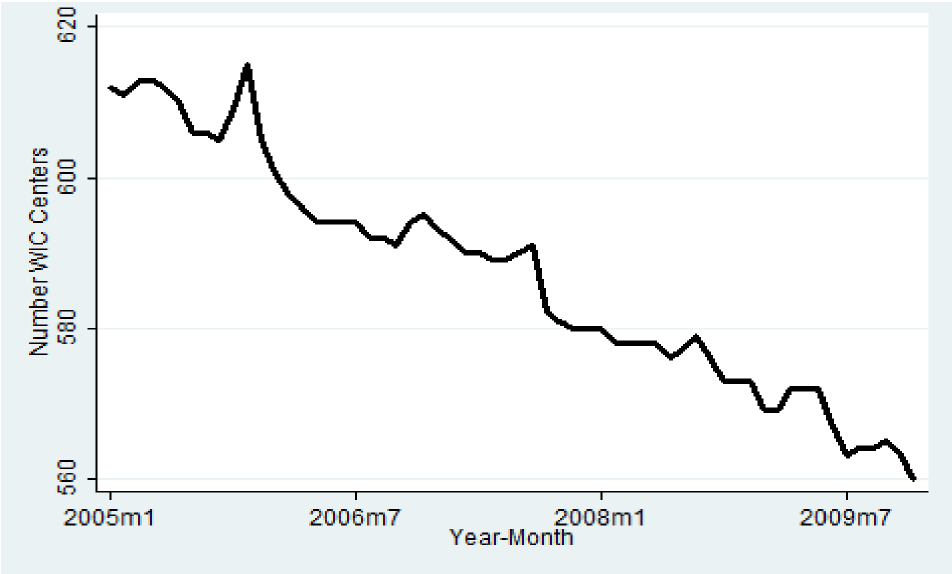
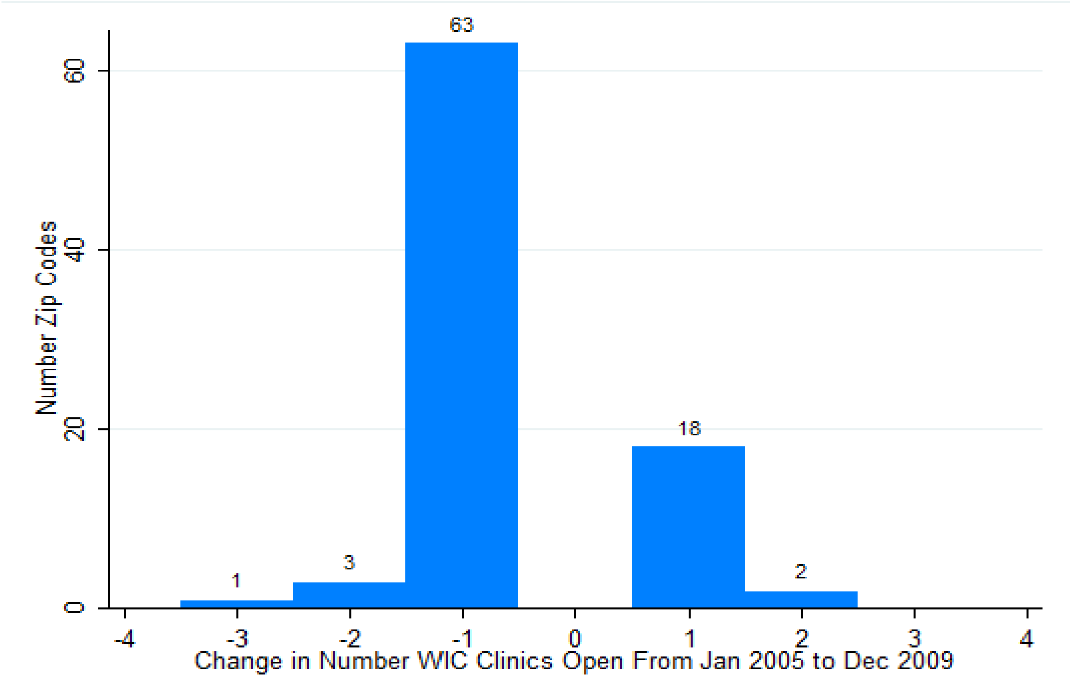
Figure 1. Number Operating WIC Clinics in Texas: 2005-2009



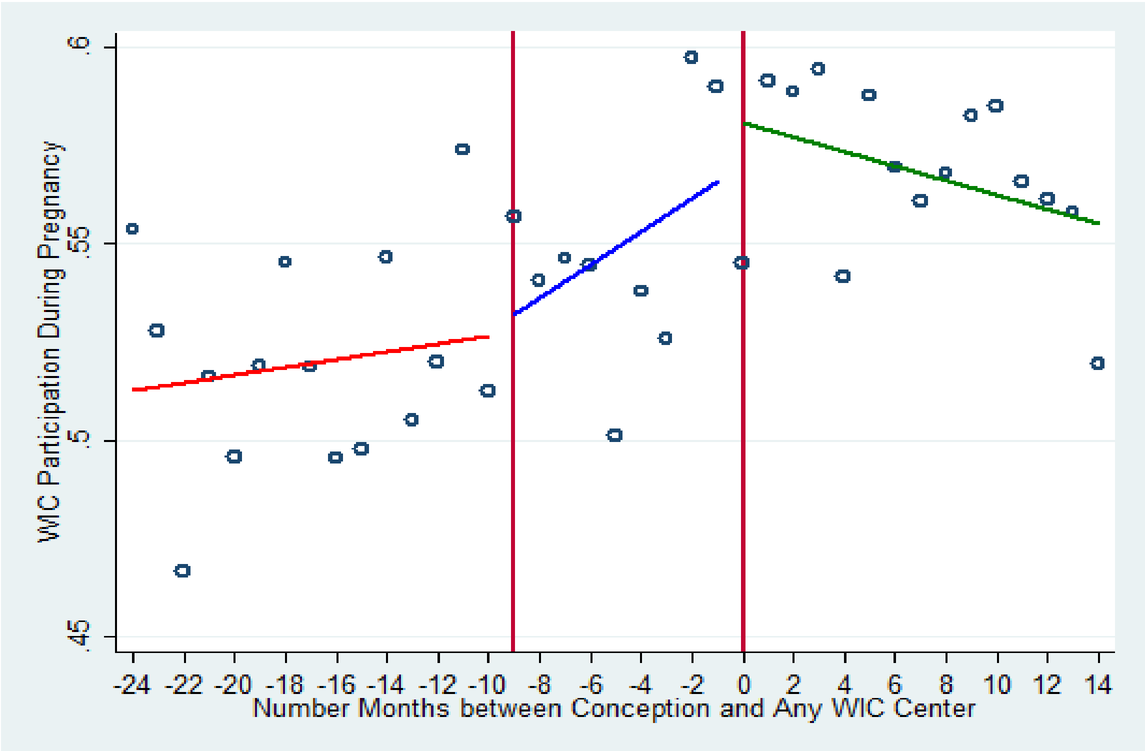
Notes: This figure plots the number of open WIC clinics in Texas by year-month from January 2005 to December 2009.

Figure 2. Variation in Within-Zip Code Number of WIC Clinics Over 2005-2009



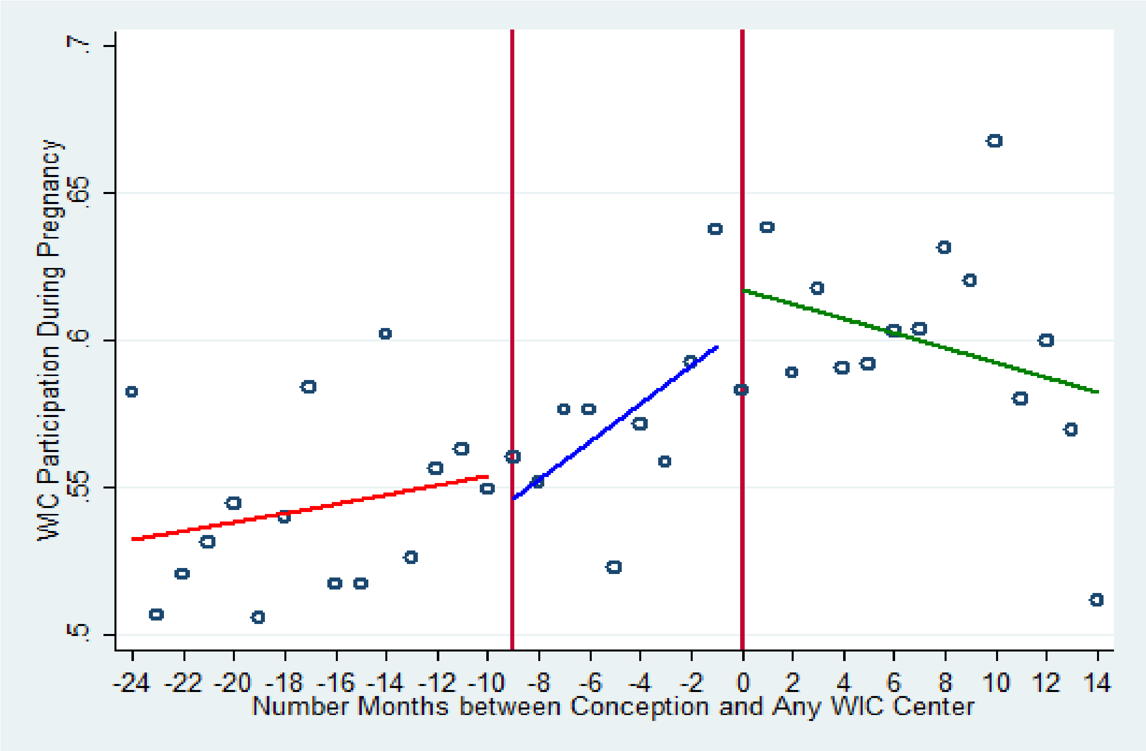
Notes: This figure is a histogram of zip codes that have had a non-zero change in the number of open WIC clinics between January 2005 and December 2009. There are 87 zip codes in Texas that had a non-zero change in the number of open WIC clinics between January 2005 and December 2009.

Figure 3. Prenatal WIC Food Receipt by Number Months Between Conception and Time of At Least One WIC Clinic Operating in Zip Code of Residence: TX Births 2005-2009



Notes: The sample of analysis consists of all singleton births in Texas over 2005-2009 with mothers who reside in Texas. This figure plots the average prenatal WIC food receipt by the number of months between conception and the time of at least one WIC clinic operating in the mother's zip code of residence. For zip codes that experience a first WIC clinic opening over 2004-2009, the x-axis plots the difference between the conception year-month and the year-month of the first WIC clinic opening. For zip codes that experience a last WIC clinic closing over 2004-2009, the x-axis plots the difference between the year-month of the last WIC clinic closing and the conception year-month. Mothers residing in zip codes that have experienced a first WIC clinic opening and a last WIC clinic closing within a 38-month period -- the time period displayed in the figure -- are dropped (5 zip codes). Consequently, conceptions plotted at positive values of the x-axis occurred when at least one WIC clinic was operating in the mother's zip code. Conceptions plotted between the values of -9 and 0 on the x-axis experienced a WIC clinic opening or closing during pregnancy. Conceptions plotted at values below -9 on the x-axis had no WIC clinic in the zip code of residence.

Figure 4. Prenatal WIC Food Receipt by Number Months Between Conception and Time of At Least One WIC Clinic Operating in Zip Code of Residence: TX Sibling Births 2005-2009



Notes: The sample of analysis consists of singleton sibling births in Texas over 2005-2009 with mothers who reside in Texas. This figure plots the average prenatal WIC food receipt by the number of months between conception and the time of at least one WIC clinic operating in the mother's zip code of residence. For zip codes that experience a first WIC clinic opening over 2004-2009, the x-axis plots the difference between the conception year-month and the year-month of the first WIC clinic opening. For zip codes that experience a last WIC clinic closing over 2004-2009, the x-axis plots the difference between the year-month of the last WIC clinic closing and the conception year-month. Mothers residing in zip codes that have experienced a first WIC clinic opening and a last WIC clinic closing within a 38-month period -- the time period displayed in the figure -- are dropped (5 zip codes). Consequently, conceptions plotted at positive values of the x-axis occurred when at least one WIC clinic was operating in the mother's zip code. Conceptions plotted between the values of -9 and 0 on the x-axis experienced a WIC clinic opening or closing during pregnancy. Conceptions plotted at values below -9 on the x-axis had no WIC clinic in the zip code of residence.

Table 1. Summary Statistics: Texas Sibling Births 2005-2009

	WHOLE SAMPLE (N=612,694)		BIRTHS BY MOTHERS WITH WIC CLINIC IN ZIP CODE DURING ANY PREGNANCY (N=360,799)		BIRTHS WITH WIC CLINIC IN ZIP CODE DURING PREGNANCY (N=297,552)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Mother Received WIC Food During Pregnancy	**0.556**	0.497	**0.647**	0.478	**0.656**	0.475
Mother's Age <20	**0.150**	0.357	**0.178**	0.383	**0.179**	0.384
Mother's Age 20-24	**0.330**	0.470	**0.370**	0.483	**0.365**	0.481
Mother's Age 25-34	**0.447**	0.497	**0.399**	0.490	**0.401**	0.490
Mother's Age 35-44	**0.073**	0.260	**0.053**	0.224	**0.055**	0.227
Mother's Ed: <HS	**0.310**	0.462	**0.371**	0.483	**0.378**	0.485
Mother's Ed: HS degree	**0.281**	0.449	**0.305**	0.460	**0.303**	0.460
Mother's Ed: Some College	**0.220**	0.415	**0.207**	0.405	**0.203**	0.402
Mother's Ed: College+	**0.188**	0.391	**0.117**	0.321	**0.116**	0.320
Mother is Married	**0.587**	0.492	**0.525**	0.499	**0.529**	0.499
Mother is Non-Hispanic White	**0.353**	0.478	**0.276**	0.447	**0.263**	0.440
Mother is Black	**0.110**	0.312	**0.107**	0.310	**0.098**	0.297
Mother is Hispanic	**0.511**	0.500	**0.601**	0.490	**0.624**	0.484
Child is Male	**0.511**	0.500	**0.510**	0.500	**0.510**	0.500
Pregnancy Weight Gain <16 lbs	**0.146**	0.354	**0.159**	0.366	**0.161**	0.368
Pregnancy Weight Gain >60 Lbs	**0.032**	0.176	**0.033**	0.177	**0.032**	0.175
Prenatal Care Received from Public Clinic	**0.092**	0.289	**0.106**	0.308	**0.109**	0.311
Diabetes	**0.035**	0.183	**0.034**	0.180	**0.034**	0.181
Gestational Hypertension	**0.043**	0.202	**0.041**	0.199	**0.041**	0.199
Eclampsia	**0.001**	0.031	**0.001**	0.032	**0.001**	0.032
Birth Paid by Medicaid	**0.480**	0.500	**0.554**	0.497	**0.553**	0.497
Birth Weight (g)	**3275.410**	517.173	**3254.084**	517.108	**3254.559**	516.061
Low Birth Weight (<2500g)	**0.060**	0.238	**0.064**	0.245	**0.063**	0.244
Very Low Birth Weight (<1500g)	**0.006**	0.080	**0.007**	0.082	**0.007**	0.081
High Birth Weight (>4000g)	**0.064**	0.245	**0.059**	0.236	**0.059**	0.235
Gestation (weeks)	**38.431**	1.748	**38.404**	1.789	**38.406**	1.786
Premature (<37 weeks)	**0.091**	0.288	**0.096**	0.294	**0.095**	0.294
Child is Breastfed at Time of Discharge	**0.745**	0.436	**0.710**	0.454	**0.709**	0.454

Notes: The sample is limited to singleton sibling births with mothers that reside in Texas over 2005-2009. Births with missing gestation length or gestation less than 26 weeks are omitted. Exposure to a WIC clinic is calculated by considering length of pregnancy from the time of conception (estimated using the child's birth date and gestation length).

Table 2. Maternal Characteristics and WIC Clinic Locations in Texas

	Mother's Age <20	Mother's Age 35-44	Mother's Ed: <HS	Mother's Ed: HS degree	Mother's Ed: Some College	Mother's Ed: College+	Mother is Married	Mother is Non-Hispanic White	Mother is Black	Mother is Hispanic
A. No Zip Code Fixed Effects										
Any WIC Clinic in Zip Code of Residence During Pregnancy	0.0553***	-0.0345***	0.1310***	0.0436***	-0.0334***	-0.1413***	-0.1128***	-0.1763***	-0.0228**	0.2202***
	(0.0045)	(0.0032)	(0.0121)	(0.0073)	(0.0057)	(0.0129)	(0.0118)	(0.0192)	(0.0099)	(0.0220)
B. With Zip Code Fixed Effects										
Any WIC Clinic in Zip Code of Residence During Pregnancy	0.0038	0.0050	-0.0080	0.0155	0.0057	-0.0134**	-0.0106	-0.0073	0.0095**	-0.0020
	(0.0066)	(0.0048)	(0.0112)	(0.0100)	(0.0077)	(0.0057)	(0.0084)	(0.0068)	(0.0036)	(0.0072)
N	612,694	612,694	612,694	612,694	612,694	612,694	612,690	612,694	612,694	612,694

Notes: Each coefficient in each panel is from a separate regression. The sample is limited to singleton sibling births with mothers that reside in Texas over 2005-2009. Births with missing gestation length or gestation less than 26 weeks are omitted. All regressions include birth year and birth month fixed effects. The regressions in Panel B also include zip code fixed effects. Robust standard errors are clustered on the zip code level.

Significance levels: +p<0.10 **p<0.05 ***p<0.001

Table 3. Linear Probability Models of the Effect of WIC Clinic During First Pregnancy on Probability of Moving Zip Codes Before Next Pregnancy

	Outcome: Mother Moved Zip Codes Between Pregnancies			
	(1)	(2)	(3)	(4)
Any WIC Clinic in Zip Code of Residence During 1st Pregnancy	-0.0611***	0.0312+	-0.0122	0.0568**
	(0.0080)	(0.0179)	(0.0210)	(0.0196)
WIC Clinic * Mother is Non-Hispanic White			-0.0128	0.0102
			(0.0146)	(0.0148)
WIC Clinic * Mother is Black			-0.0163	-0.0228
			(0.0187)	(0.0178)
WIC Clinic * Mother is Hispanic			-0.0325+	-0.0256
			(0.0174)	(0.0182)
WIC Clinic * Mother's Age 20-24			0.0044	0.0038
			(0.0064)	(0.0062)
WIC Clinic * Mother's Age 25-34			0.0381***	0.0292**
			(0.0098)	(0.0094)
WIC Clinic * Mother's Age 35-44			0.0563***	0.0474***
			(0.0137)	(0.0135)
WIC Clinic * Mother's Age 45+			0.0431	0.0527
			(0.0801)	(0.0837)
WIC Clinic * Mother's Ed <HS			-0.0387**	-0.0422**
			(0.0140)	(0.0130)
WIC Clinic * Mother's Ed HS Degree			-0.0534***	-0.0475***
			(0.0132)	(0.0120)
WIC Clinic * Mother's Ed Some College			-0.0358**	-0.0330***
			(0.0112)	(0.0097)
WIC Clinic * Mother is Married			0.0260***	0.0212***
			(0.0060)	(0.0055)
WIC Clinic * Number Children			-0.0195**	-0.0146**
			(0.0060)	(0.0053)
Constant	0.1346***	0.0640***	0.1266***	0.0633***
	(0.0132)	(0.0136)	(0.0156)	(0.0135)
First Zip Code of Residence FE	No	Yes	No	Yes
N	612,690	612,690	612,690	612,690

Notes: Each column is a separate regression. The sample is limited to singleton sibling births with mothers that reside in Texas over 2005-2009. Births with missing gestation length or gestation less than 26 weeks are omitted.
In addition to the listed covariates, all regressions include main effects for mother's race, age, education, marital status, and number of children as well as birth year and birth month fixed effects. The regressions in the 2nd and 4th columns also include fixed effects for the mother's first zip code of residence. All robust standard errors are clustered on the mother's first zip code of residence.
Omitted categories: mother's race - other; mother's age <20; mother's education college+; mother is unmarried.
Significance levels: +p<0.10 **p<0.05 ***p<0.001

Table 4. Effects of WIC Clinic Access in Zip Code of Residence on WIC Food Receipt: Texas Births 2005-2009

	Dependent Variable: Mother Received WIC Food During Pregnancy							
	All Texas Singleton Births		Texas Sibling Singleton Births					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Zip FE	Zip FE and County Time Trends	Zip FE	Zip FE and County Time Trends	Mother FE	IV-Mother FE	IV-Mother FE; HS Education or Less at Time of First Birth	IV-Mother FE; First Birth Paid by Medicaid
Any WIC Clinic in Zip Code of Residence During Pregnancy	0.0147**	0.0148**	0.0221**	0.0220**	0.0075**	0.0308**	0.0443**	0.0398+
	(0.0075)	(0.0074)	(0.0084)	(0.0083)	(0.0023)	(0.0138)	(0.0185)	(0.0232)
N	1,918,123	1,918,123	607,002	607,002	607,002	607,002	366,865	281,838

Notes: Each coefficient is from a separate regression. The sample is limited to singleton births with mothers that reside in Texas over 2005-2009. Births with missing gestation length or gestation less than 26 weeks are omitted. Columns 3-8 additionally limit the sample to sibling births only. In columns 3-8, for each outcome, births by mothers who have at most one child with non-missing data for that outcome are omitted. Exposure to a WIC clinic is calculated by considering length of pregnancy from the time of conception (estimated using the child's birth date and gestation length).
The first 4 columns present results from OLS regressions that include controls for mother's race (non-Hispanic white, black, Hispanic), mother's age (<20, 20-24, 25-34, 35-44, 45+), mother's education (<HS, HS, some college, college+, missing), mother's marital status (married, not married), birth order, as well as birth year, birth month, and zip code fixed effects. Columns 2 and 4 additionally include county-specific linear time trends. Column 5 presents results from regressions with mother fixed effects, as well as birth year and birth month fixed effects. All controls are the same as in the first 4 columns, except time-invariant indicators for race are omitted. Column 6 presents results from regressions with mother fixed effects where the key variable of interest is instrumented by an indicator for any WIC clinic during the current pregnancy assuming it had lasted 39 weeks and assuming that the mother remained at her first pregnancy zip code. Controls in column 6 are the same as in column 5. Columns 7 and 8 present results using the same estimation as in column 5, except limiting the sample to mothers who had a high school education or less at the time of the first birth and whose first births were paid by Medicaid, respectively. In columns 1-5, robust standard errors are clustered on the zip code of residence. In columns 6-8, robust standard errors are clustered on the mother's first zip code of residence.
Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Table 5. Effects of WIC Clinic Access in Zip Code of Residence on Pregnancy Behaviors and Conditions: IV-Mother FE

	Weight Gain <16 Lbs	Weight Gain >60 Lbs	Prenatal Care Received from a Public Clinic	Diabetes	Gestational Hypertension	Eclampsia	Birth Paid by Medicaid
A. All Mothers							
Any WIC Clinic in Zip Code of Residence During Pregnancy	-0.0172+	0.0074	0.0082	0.0070	0.0129**	0.0001	0.0499
	(0.0091)	(0.0051)	(0.0242)	(0.0049)	(0.0049)	(0.0008)	(0.0512)
N	589,574	589,574	612,686	612,686	612,686	612,686	604,661
B. Mothers with High School Degree or Less at Time of First Birth							
Any WIC Clinic in Zip Code of Residence During Pregnancy	-0.0317**	0.0036	0.0147	0.0127**	0.0130**	0.0005	0.0605
	(0.0127)	(0.0068)	(0.0352)	(0.0047)	(0.0056)	(0.0011)	(0.0627)
N	355,376	355,376	371,533	371,533	371,533	371,533	364,953

Notes: Each coefficient in each panel is from a separate regression. See notes under Table 4 for more information about the sample and IV-Mother FE estimation method.

Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Table 6. Effects of WIC Clinic Access in Zip Code of Residence on Birth Outcomes: IV-Mother FE

	Birth Weight (g)	Low Birth Weight (<2500g)	Gestation (weeks)	Premature (<37 weeks)	Child Breastfed
A. All Mothers					
Any WIC Clinic in Zip Code of Residence During Pregnancy	27.3023**	-0.0053	0.0582	-0.0037	0.0201
	(7.9839)	(0.0056)	(0.0417)	(0.0109)	(0.0168)
N	612,640	612,640	612,686	612,686	608,982
B. Mothers with High School Degree or Less at Time of First Birth					
Any WIC Clinic in Zip Code of Residence During Pregnancy	32.5030***	-0.0100+	0.0711	-0.0054	0.0405**
	(8.9690)	(0.0053)	(0.0569)	(0.0126)	(0.0185)
N	371,504	371,504	371,533	371,533	369,000

Notes: Each coefficient in each panel is from a separate regression. See notes under Table 4 for more information about the sample and IV-Mother FE estimation method.
Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Table 7. Placebo Effects of WIC Clinics on Prenatal WIC Food Receipt, Birth Weight, and Breastfeeding: Texas Sibling Births 2005-2009

	Dependent Variable: Mother Received WIC Food During Pregnancy				Dependent Variable: Birth Weight (g)				Dependent Variable: Child is Breastfed at Time of Discharge			
	Zip FE	Zip FE & County Time Trends	Mother FE	IV-Mother FE	Zip FE	Zip FE & County Time Trends	Mother FE	IV-Mother FE	Zip FE	Zip FE & County Time Trends	Mother FE	IV-Mother FE
A. All Mothers												
At Least One WIC Clinic 3-6 Months Before or After Pregnancy & No WIC Clinics During Pregnancy	-0.0012	-0.0013	-0.0034	-0.0031	-8.8582	-8.8695	-19.9775	-35.4600	0.0047	0.0045	-0.0062	-0.0107
	(0.0154)	(0.0154)	(0.0176)	(0.0179)	(17.5737)	(17.5241)	(20.7472)	(23.5515)	(0.0108)	(0.0108)	(0.0147)	(0.0185)
At Least One WIC Clinic 6-9 Months Before or After Pregnancy & No WIC Clinics During Pregnancy	-0.0047	-0.0047	-0.0201	-0.0051	1.5355	0.7957	16.0030	29.3213	0.0041	0.0030	0.0122	0.0237
	(0.0118)	(0.0118)	(0.0161)	(0.0183)	(18.7600)	(18.7264)	(23.3029)	(21.9082)	(0.0142)	(0.0142)	(0.0150)	(0.0189)
N	607,002	607,002	607,002	607,002	612,640	612,640	612,640	612,640	608,982	608,982	608,982	608,982
B. Mothers with High School Degree or Less at Time of First Birth												
At Least One WIC Clinic 3-6 Months Before or After Pregnancy & No WIC Clinics During Pregnancy	0.0035	0.0036	-0.0051	-0.0058	-26.0558	-26.1545	-24.9839	-44.4283+	-0.0223	-0.0226	-0.0365+	-0.0517+
	(0.0229)	(0.0229)	(0.0246)	(0.0271)	(23.2901)	(23.3007)	(22.4614)	(23.6391)	(0.0144)	(0.0144)	(0.0189)	(0.0305)
At Least One WIC Clinic 6-9 Months Before or After Pregnancy & No WIC Clinics During Pregnancy	-0.0204	-0.0209	-0.0338	-0.0197	7.2430	6.0043	32.4890	43.7363	0.0126	0.0112	0.0269	0.0237
	(0.0191)	(0.0191)	(0.0244)	(0.0301)	(20.1771)	(20.1609)	(27.2863)	(28.0755)	(0.0201)	(0.0203)	(0.0192)	(0.0227)
N	366,865	366,865	366,865	366,865	371,504	371,504	371,504	371,504	369,000	369,000	369,000	369,000

Notes: Each column in each panel is from a separate regression. See notes under Table 4 for more information about the sample and estimation methods. The key explanatory variables of interest are indicators that are equal to 1 if a first WIC clinic opens in the mother's zip code of residence 3-6 and 6-9 months after childbirth or if a last WIC clinic closes in the 3-6 and 6-9 months before conception, and zero otherwise.

Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Table 8. Effects of WIC Clinic Access on Births in Texas

	Total Number Births	Log Total Births	Total Number Sibling Births	Log Sibling Births
Any WIC Clinic in Zip Code of Residence During Pregnancy	-0.5100	0.0076	-0.3808	0.0059
	(0.4162)	(0.0201)	(0.4843)	(0.0260)
N	94,796	94,796	76,945	76,945

Notes: Each coefficient is from a separate regression. Units of analysis are residence zip code - birth year - birth month cells. In the first two columns, the sample includes the universe of Texas singleton births over 2005-2009. The last two columns use the siblings sample. All regressions include birth year, birth month, and zip code fixed effects. Robust standard errors are clustered on the zip code level. Significance levels: +p<0.10 **p<0.05 ***p<0.001

Appendix Table 1. First Stage/Reduced Form for IV-Mother FE

	First Stage: Any WIC Clinic in Zip Code of Residence During Pregnancy	Reduced Form: WIC Food Receipt During Pregnancy
Any WIC Clinic in Zip Code of Residence at FIRST Birth During Current Pregnancy, Assuming 39 Weeks Gestation	0.7617***	0.0234+
	(0.0173)	(0.0123)
R-squared	0.6341	0.7662
N	607,002	607,002

Notes: The F-statistic for the first stage is 1934.99. See notes under Table 4 for more information about the sample and estimation methods.
Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Appendix Table 2. Geographic Access to WIC: Urban vs. Rural Zip Codes, IV-Mother FE Method

	Dependent Variable: Mother Received WIC Food During Pregnancy	
	Urban Zip Codes	**Rural Zip Codes**
Any WIC Clinic in Zip Code of Residence During Pregnancy	0.0354**	0.0019
	(0.0148)	(0.0257)
N	507,851	76,449

Notes: Each coefficient is from a separate regression. See notes under Table 4 for more information about the sample and IV-Mother FE estimation method.
Significance levels: +p<0.10 ** p<0.05 *** p<0.001.

Appendix Table 3. Effects of WIC Clinic Access in Zip Code of Residence on WIC Food Receipt: Alternative Definitions of WIC Clinic Access

	Dependent Variable: Mother Received WIC Food During Pregnancy					
	Zip FE	**Mother FE**	**IV-Mother FE**	**Zip FE**	**Mother FE**	**IV-Mother FE**
Any WIC Clinic in Zip Code of Residence Open During **Entire** Pregnancy	0.0209**	0.0072**	0.0234**			
	(0.0102)	(0.0022)	(0.0113)			
Fraction of Time During Pregnancy At Least One WIC Clinic Open in Zip Code of Residence				0.0237**	0.0073**	0.0316**
				(0.0109)	(0.0023)	(0.0138)
N	607,002	607,002	607,002	607,002	607,002	607,002

Notes: Each coefficient is from a separate regression. See notes under Table 4 for more information about the sample and estimation methods. In the first three columns, the key explanatory variable of interest is an indicator for any WIC clinic being open during the entire pregnancy in the mother's zip code of residence. In the last three columns, the key explanatory variable of interest is a continuous variable that is equal to the fraction of days during the pregnancy duration that at least one WIC clinic was operating in the mother's zip code of residence.
Significance levels: +p<0.10 ** p<0.05 *** p<0.001.