Efficiency Versus Equity in the Provision of In-Kind Benefits: Evidence from Cost Containment in the California WIC Program*

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Abstract

In many U.S. public programs, the government contracts with private firms to deliver in-kind benefits to recipients. These public-private partnerships generate agency problems that could drive up costs and lower program efficiency, but cost containment regulations may discourage firm participation and reduce access among eligible households. We examine these trade-offs in the context of California's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which provides vouchers to low-income pregnant women and children under five to obtain free food packages from private vendors, and has complex rules about eligible products. We use variation from a 2012 cost containment reform, which resulted in a 55 percent drop in the number of small vendors, and examine how local access to small vendors affects WIC take-up among pregnant women. We find that within-ZIP-code access to small vendors raises the likelihood of WIC take-up among first-time mothers, and that this effect is stronger for foreign-born than U.S.-born women and exists even for mothers who also have access to a larger WIC vendor. Our findings suggest that small vendors are uniquely effective at lowering barriers to take-up among subgroups of women with high program learning costs, and that cost containment reforms, which frequently target these vendors, may have unintended consequences of inequitably reducing program access.

Keywords: WIC program, benefit take-up, in-kind transfers, cost containment
JEL: H40, I18, I38

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1 Introduction

An expansive body of research documents the lasting consequences of the early-life environment on adult outcomes (Almond *et al.*, 2018; Almond and Currie, 2011; Barker, 1990). Correspondingly, a recent analysis of 133 public policies finds that programs that target young children, rather than adults, generate the "largest bang for the buck," as measured by the Marginal Value of Public Funds (MVPF) (Hendren and Sprung-Keyser, 2019).[1] Further, among such programs, those that provide in-kind transfers (e.g., early childhood health or educational interventions) tend to deliver higher value than those that provide cash.[2]

However, the structure of in-kind benefit provision in the United States creates challenges for balancing the goals of program efficiency and equity. In many programs, the government relies on private firms to deliver in-kind benefits,[3] which can generate agency problems—if the incentives of private contractors do not align with the goal of maximizing welfare among program beneficiaries, firms may engage in wasteful activities that increase costs without adding value for the benefit recipients. But regulations aimed at curbing costs may have the unintended consequence of discouraging participation by firms, which could reduce program access among eligible households. Moreover, such regulations may shift the composition of participating vendors (e.g., small versus large firms), which may impact the types of households that participate in the program. For example, compared to large chain companies, small independent firms may be more likely to offer services that reflect the specific needs of their customer base (e.g., bilingual staff, see Waldfogel, 2007).

This paper examines these issues in the context of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the chief U.S. public program that targets the health and nutrition of low-income pregnant women and children under age five. The WIC program distributes its benefits via quantity vouchers, which recipients redeem at participating stores for specific types and amounts of nutritious products (e.g., 16 ounces of

[1]The MVPF represents the ratio of each program's benefits to the net government costs. Benefits are measured by the policy recipients' willingness to pay, while net costs include both program spending and the long-term effect of the policy on the government's budget. See Hendren and Sprung-Keyser (2019) for more details.

[2]In-kind transfers that are used to alter recipient consumption patterns may be welfare-improving if expanding recipients' budget constraints through unrestricted cash transfers results in loss (e.g., if a mother does not fully internalize the importance of the health of her child). See Moffitt (1983) and Currie and Gahvari (2008) for broader discussions about in-kind transfers.

[3]For instance, Medicaid—the nation's main public health insurance program for low-income families with children—primarily operates by reimbursing private Medicaid Managed Care plans instead of insuring beneficiaries directly. The Head Start program provides funding to private for-profit organizations for the purpose of operating preschools for low-income children in local communities (in addition to providing funding to local public agencies, non-profit organizations, tribal governments, and school systems). The National School Lunch Program contracts with food service management companies to prepare and deliver lunches to poor children in schools.

whole wheat bread). Vendors are often viewed critically by the program's administration due to their incentives to raise the program's fiscal burden. In particular, since WIC beneficiaries are completely price-inelastic—WIC benefits only specify product types and quantities, but *not* prices—vendors have an incentive to increase the prices charged for WIC-eligible products. Existing evidence suggests that such strategic pricing responses to price-inelastic WIC customers are concentrated among small, independent grocers rather than large grocery chains (Meckel, 2018; Saitone *et al.*, 2013), making small vendors frequent targets of various cost containment reforms.

At the same time, small stores may play an important role in lowering barriers to take-up for certain types of households. Large chain grocers are less likely to locate in high-poverty areas (Bitler and Haider, 2011; Alcott *et al.*, 2019), which means that small stores may raise program awareness and facilitate access for households residing in these areas. In addition, small grocers may offer an environment in which learning WIC's complex product eligibility rules is more feasible. In the store, participants must locate eligible products, which are defined based on size, flavor, ingredients, and other characteristics. Qualitative data from interviews with WIC participants underscores the difficulties that they experience when using WIC benefits at large stores that also contain many other ineligible items (Grodsky *et al.*, 2017). Independent ethnic grocers that operate as WIC vendors may further lower these costs for immigrant participants, who may be less familiar with American brands and sizing conventions. Surveys indicate that some foreign-born shoppers prefer independent grocers to larger supermarkets because they have bilingual staff and signage (Ayala *et al.*, 2005; Sanchez-Flack *et al.*, 2016).[4] An additional benefit of small WIC stores is that they may provide a less stigmatizing shopping experience than larger retailers that serve mostly non-WIC customers.[5]

To analyze the impacts of vendors on program take-up, we focus on a major cost containment reform in California's WIC program. The reform occurred in response to the U.S. Department of Agriculture (USDA) and the California Department of Public Health (CDPH) identifying over-pricing of WIC foods among small vendors.[6] The two centerpieces of the reform were: (1) a moratorium on all new vendor applications from April 2012 to June 2014 and (2) a decrease in the reimbursement rate for small vendors in May 2012. We hand-collected data on the names and exact addresses of all authorized WIC vendors in

[4]Relatedly, it may be that local shop owners are more invested in local good provision than national chains because they have a stake in the community.

[5]See Moffitt (1983) and Currie and Gahvari (2008) for discussions about stigma in welfare program participation and the role of in-kind benefits.

[6]See: `https://californiahealthline.org/news/public-health-department-lifts-vendor-moratorium-for-wic-` for more details on the issues.

California from March 2010 to December 2015, classified them by type, and found that the number of small vendors targeted by the reform fell from a peak of 1,904 in February 2012 to 851 in December 2015, a 55 percent decrease. Data from the USDA further shows that average WIC food costs per participant in California fell from a peak of $63.47 in August 2011 to $42.37 in December 2015 (in 2010$), a 33 percent reduction.

We merge our novel WIC vendor data set to California birth records data covering the universe of births over 2010-2015 with information on maternal ZIP code tabulation area (ZCTA) of residence and WIC benefit take-up during pregnancy. We exploit the reform-induced variation in the presence of WIC vendors within ZCTAs and over time to study how proximity to different types of vendors affects WIC take-up during pregnancy. Importantly, while there is a substantial amount of variation in the presence of small WIC vendors due to the reform, the number of large WIC grocers (e.g., major grocery chains such as Wal-Mart and Vons) remained relatively stable over the sample time period, and over 95 percent of mothers in our data have at least one WIC vendor (of any type) in their ZCTA of residence during pregnancy. Thus, our empirical setting allows us to identify the distinct impacts of proximity to small stores among mothers that already have access to a larger vendor in their ZCTA.

We find that among all mothers in our data, the presence of a small WIC vendor within a mother's ZCTA is associated with a 0.8 percentage point increase in the likelihood she receives WIC benefits during her pregnancy (1.6 percent at the sample mean). The small average effect on take-up masks important subgroup heterogeneity, however. We begin by distinguishing between first-time mothers, who are newly eligible for WIC, and women giving birth to higher-order children, who may have participated in the past. Our results show that among women with first births, the presence of a small WIC vendor in their ZCTA of residence during pregnancy increases the likelihood of benefit take-up by 1.4 percentage points (3.1 percent at the sample mean). By contrast, for women giving birth to higher-parity children, the effect of a small vendor is small and insignificant. The increase in take-up for first-time mothers exists even among those who also have a large WIC grocer in their ZCTA, suggesting that the "learning" channel could be important in explaining the distinct role of small stores.[7]

That said, *within*-ZCTA differences in distance to stores may also be important. We find

[7]We also present evidence from the American Time Use Survey (ATUS) that is consistent with the notion that first-time mothers face especially high learning costs when using the WIC program—WIC households with only one child spend significantly more time grocery shopping than WIC households with multiple children or other non-WIC-participating low-income households. In addition, interviews with WIC recipients suggest a learning curve in identifying WIC-eligible products that dissipates with time spent in the program (Chauvenet *et al.*, 2019).

that small WIC vendors are on average located in Census tracts that have a 3.3 percentage point higher poverty rate than large vendors in the *same* ZCTA, which is a non-trivial difference relative to the average poverty rate of 12.8 percent across all tracts with small or large vendors in our data. As a result, the reform—which reduced the number of small vendors while holding the number of large vendors constant—generated a disproportionate reduction in WIC access and salience in the poorest areas in California.

Moreover, we find that foreign-born first-time mothers experience larger participation gains from having small vendors in their ZCTAs than their U.S.-born counterparts (3.8 percent versus 2.7 percent, respectively). This pattern suggests that small vendors—especially independent ethnic grocers—may be particularly well-suited for assisting non-native English speakers with identifying eligible product sizes, ingredient lists, and other product characteristics. It is also possible that small grocers encourage take-up through increasing awareness and information within immigrant social networks (Figlio *et al.*, 2015).

Lastly, we study whether proximity to so-called "A-50" WIC vendors—which are specialized small stores that derive 50 percent or more of their revenues from WIC customers and were indirectly affected by the cost containment reform (see Section 2 for more details)—influences take-up. We find some evidence that distance to the nearest A-50 vendor reduces take-up for foreign-born first-time mothers, but not for other subgroups. The fact that the effect of proximity to a small non-A-50 store is similar to (and, for some subgroups, stronger than) the effect of proximity to an A-50 vendor suggests that stigma may not be the primary barrier to program take-up, and that small stores need not serve mostly WIC customers in order to facilitate program access among high-need groups.

Our paper makes several contributions to the existing literature. Our analysis is related to Meckel (2018), who studies the effects of an electronic payment reform in the Texas WIC program that prevented WIC stores from charging different prices to their WIC and non-WIC customers. She finds that the reform led to a decline in participation among independent WIC vendors and reduced WIC take-up among eligible pregnant women. Our study differs from Meckel (2018) in a few important ways. While Meckel (2018) examines a policy that indirectly affected WIC vendors' incentive to participate due to a reduction in the payoff from being in the program (via the prohibition of price discrimination), we instead analyze a cost containment reform that more directly decreased the number of small vendors through a moratorium and an explicit reduction in reimbursement rates. Thus, by directly targeting small vendors, California's reform led to a disproportionate decline in access among the relatively less advantaged women who rely on these stores to redeem their benefits. Our results suggest that while cost containment measures in public-private in-kind benefit provision contracts may increase program efficiency by lowering costs, they may also

reduce equity by lowering access for vulnerable subgroups. Further, our empirical setting allows us to identify the distinct effects of proximity to small vendors among women that also have access to larger WIC stores. We are therefore able to shed light on the unique role these vendors play in reducing barriers to take-up for subgroups that face high program learning costs (e.g., first-time mothers and immigrants).[8]

More broadly, our study relates to a literature that emphasizes the role of transaction costs in determining the take-up of social programs (Currie, 2006). One strand of this literature argues that although transaction costs lower overall take-up, they may be desirable if they increase the targeting of benefits toward the needy by differentially deterring utilization among individuals for whom the benefit value is low (Kleven and Kopczuk, 2011; Nichols and Zeckhauser, 1982; Besley and Coate, 1992). Consistent with this idea, recent experimental work finds that lowering informational barriers and time costs *decreases* targeting in the Supplemental Nutrition Assistance Program (SNAP), as the marginal participants induced to sign up by the treatment receive lower benefit amounts on average (Finkelstein and Notowodigdo, 2018). In contrast, we provide evidence that a reduction in transaction costs due to within-ZCTA availability of a small WIC grocer *increases* targeting in WIC, as poor immigrant families are differentially induced to take up benefits.[9] Our finding of a negative relationship between transaction costs and targeting echoes the conclusions of recent work by Deshpande and Li (2017), who show that closures of Social Security Administration field offices (i.e., an increase in transaction costs) reduce disability benefit take-up differentially among individuals with higher benefit amounts (i.e., consistent with a decrease in targeting).

Finally, our findings are relevant to other in-kind transfer programs in which beneficiaries must learn about unfamiliar goods or services, and the resulting learning costs generate barriers to take-up. For example, recent evidence suggests that housing voucher program participants who receive mobility counseling and housing search assistance are more likely to move from lower income to higher income areas (Collinson *et al.*, 2019). Our results suggest that counseling interventions in the WIC program may be particularly helpful for first-time users and those who have recently moved from a different country.

[8]We also build on a small set of studies on the geographic determinants of WIC take-up, which focus on proximity to WIC agencies and clinics, where individuals must go to apply for their benefits (Bitler *et al.*, 2003; Hoynes *et al.*, 2011; Rossin-Slater, 2013). We instead focus on proximity to vendors, which are key access points because they are the places where participants must *redeem* their benefits.

[9]Children of immigrant parents are substantially more likely to live in low-income families than non-immigrant children. For example, in California, 54 percent of children of immigrant parents live in low-income families, compared to 36 percent of children of native-born parents. Source: `http://www.nccp.org/profiles/CA_profile_6.html`.

2 Background

The WIC program was implemented in 1974 with the goal of improving the health and nutritional well-being of low-income pregnant women and their young children. Recipients are issued monthly quantity vouchers that they redeem for a specific set of nutritional foods at participating private vendors ("WIC stores"). To be eligible, beneficiaries must live in households with incomes below 185 percent of the poverty line and to be "at nutritional risk," although the latter requirement rarely binds.[10] Annual expenditure on WIC was $5.4 billion in 2018, and it served 1.6 million women, 1.7 million infants (approximately 50 percent of infants nationwide), and 3.5 million children per month.[11]

California WIC is the largest state program, serving over one million women and children in 2018, or 15 percent of participants nationwide. Eligibility verification and voucher distribution occurs at WIC clinics, which exist in a variety of locations, including public health departments, medical centers, community centers, schools, and churches. Participants must return to these clinics every three months to receive a booklet of benefit vouchers that covers the subsequent three months. Additional services, such as nutritional counseling and health screenings, are also provided at the three-month clinic appointments.

Monthly food benefits are assigned based on eligibility category (pregnant woman, postpartum mother, infant, or child), as well as additional factors (breastfeeding status, dietary restrictions, availability of refrigeration, etc.). As an example, in California in 2019, a pregnant woman could obtain the following food package on a monthly basis: 4.5 gallons milk (lowfat or nonfat only), 36 ounces of breakfast cereal, 16 ounces of whole grains, 32 ounces of yogurt, one dozen eggs, 16 ounces of cheese, 144 ounces of juice, 16 or 18 ounces of peanut butter, and 16 ounces of beans.[12]

Product eligibility is restricted based on a complex set of rules involving packaging size, fat content, flavor, brand, and other attributes.[13] For example, cheese must be in a 16 ounce package and of the following varieties: cheddar, mozzarella, colby, or jack, or a blend of these varieties. Cheese may not have added ingredients (e.g., jalapeño) and cannot be: organic,

[10] 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 are counseled at WIC about these risks and the outcomes influenced by nutrition education and nutritious foods provided by WIC. See: `https://www.benefits.gov/benefits/benefit-details/2041` for more details.

[11] Information about WIC program participation and funding is available at `https://www.fns.usda.gov/pd/wic-program`.

[12] Source: `http://cms.sbcounty.gov/wic/WICFoods/FoodPackages.aspx`.

[13] California makes available a 19-page guide to these rules. See `https://www.cdph.ca.gov/Programs/CFH/DWICSN/Pages/WICFoods.aspx`.

diced, grated, sliced, crumbled, or shredded. For other foods, such as yogurt, eligibility is further restricted to approved brands. Inside a WIC store, participants must locate the eligible foods themselves and bring them to the register for checkout, where eligibility is verified by the cashier.[14]

WIC's product eligibility rules are meant to ensure the nutritional value of distributed foods as well as to contain costs (e.g., by avoiding high-price brands).[15] However, these numerous restrictions may make the process of shopping as a WIC beneficiary onerous and time-consuming, particularly for new participants. Qualitative research finds that WIC recipients report a "learning curve" in finding eligible products with respect to one's time on the program, so that those who have participated for longer can more quickly identify eligible items (Chauvenet *et al.*, 2019).

Shopping Time by WIC Participation. To provide further evidence of a "learning curve" for participating in the WIC program, we present descriptive evidence on differences in time spent grocery shopping between WIC participants and other low-income families using data from the 2016 American Time Use Survey (ATUS).[16] Importantly, for our purposes, the 2016 ATUS includes a module called "Eating and Health" that asks respondents whether they participate in WIC ("In the last 30 days, did you or any member of your household receive benefits from the WIC program, that is, the Women, Infants, and Children program?") as well as their income relative to the poverty level and the number of children in their household.

We limit our sample to individuals in households with incomes under 185 percent of the poverty line (i.e., the cut-off for WIC eligibility) and for whom we observe time spent shopping in grocery stores. We then calculate average time per grocery shopping trip for the following subgroups of this sample, applying ATUS survey weights: individuals in households with zero children, individuals in WIC households with one child, individuals in WIC households with two or more children, individuals in non-WIC households with one child, and individuals in non-WIC households with two or more children.[17]

If the shopping experience for new WIC households involves a learning curve, then we should expect to see that WIC households with one child spend more time shopping than

[14]For some foods, such as cereal, different combinations are possible based on size (i.e., ounces), requiring participants to perform calculations while shopping.

[15]From the USDA: "The process [of choosing eligible foods] involves maximizing the nutritional value of WIC food packages while at the same time managing cost." Source: `https://www.fns.usda.gov/wic/about-wic-wic-glance`.

[16]The ATUS is a nationally representative survey run by the Bureau of Labor Statistics that interviews individuals aged 15 and over who participate in the Current Population Survey.

[17]We drop individuals for whom the response to the question about WIC participation is missing/blank and define "non-WIC" households as those who specifically answered "No" to the WIC question.

WIC households with two or more children, on average. Since there may be other reasons why households with one child and households with two or more children spend different amounts of time grocery shopping, we also consider differences in shopping time between low-income households who report that they do not participate in WIC. Low-income households with no children, who are mostly ineligible for WIC (indeed, none report participating in our sample), are another comparison group.

Figure 1 depicts the average time spent shopping per subgroup. The results are in line with a learning curve. WIC households with one child spend much more time shopping than the other groups: 76.9 minutes on average, compared with 51.0 minutes for WIC households with two or more children. The other groups all spend approximately 40 minutes per shopping trip. Notably, the average for low-income non-WIC households by child parity is quite similar—37.9 minutes for the one-child households and 38.9 for households with two or more children.

These results indicate that first-time mothers are likely to benefit from WIC vendors that are easier to navigate and better at helping participants learn which products are eligible and which aren't. We explore this conjecture through subgroup analyses in Section 5 below.

2.1 WIC Vendors and Cost Containment in California WIC

In California, WIC-authorized vendors consist of private food retailers of varying sizes and formats. Supercenters (e.g., Wal-Mart), large grocery chains (e.g., Vons), as well as small grocery, convenience, and even liquor stores can operate as WIC vendors. When WIC participants use their benefits, vendors are reimbursed by the WIC program as follows: During the WIC transaction, the cashier writes down the total value of foods distributed on an indicated space on the participant's voucher.[18] Then, the WIC vendor submits by mail the vouchers they have received, and California WIC reimburses them via deposits into a joint checking account.

Importantly, because WIC participants are provided with fixed quantities of food regardless of the shelf prices, they are completely price-inelastic. Therefore, WIC vendors have an incentive to charge higher prices for WIC-eligible products to increase their profits. In fact, some WIC vendors—particularly smaller ones—have been found to charge *different* prices to WIC and non-WIC customers, although doing so is fraudulent according to WIC program rules (Government Accountability Office, 1999; Kamara *et al.*, 2012; Saitone *et al.*, 2015). To avoid illegal price discrimination, other vendors may choose to serve primarily or only WIC customers, and charge higher prices overall.

[18]Note that since WIC transactions are not taxed, they are not processed like other transactions through the cash register.

To limit such responses, California WIC caps reimbursements using a price ceiling called the maximum allowable department reimbursement (MADR). The MADR varies across groups of vendors known as "peer groups". In particular, vendors are first categorized based on whether or not they derive more than 50 percent of their food revenues from WIC; those that do are labeled as "A-50" vendors ("Above 50"). Until 2012, non-A-50 vendors were further categorized into peer groups according to store size (three groups based on the number of cash registers: 1-2 registers, 3-4 registers, and 5+ registers) and geographic region. For each WIC product, the MADR was set using a function of the average prices for that product *within* each peer group; for A-50 vendors, the MADR was a function of prices in *all other* stores. This structure created a strong incentive for small *non*-A-50 vendors to charge exorbitantly high prices for WIC goods, as they were reimbursed by the program based on the average within the small store peer group only. For example, a 2012 *New York Times* article reported on a small California retailer charging $7.80 for a package of tortillas, which was reimbursed entirely by the program (Mieszkowki, 2012).

To combat this problem, the USDA mandated that the California WIC program issue a moratorium on all new WIC vendor applications, starting in April 2012. The moratorium was to be be lifted once California had demonstrated its ability to control costs among its small vendors. Accordingly, in May 2012, California WIC changed the MADR for small stores to be a function of the competitive statewide average of prices of goods in large stores with five or more cash registers.[19] This reform resulted in a substantial drop in the reimbursement rate for small non-A-50 vendors. The A-50 vendors, whose MADR remained a function of the average prices in *all* other stores, also experienced a drop in their reimbursement rate, albeit indirectly.[20] The moratorium was lifted in June 2014.

Figure 2 uses data from the USDA Food & Nutrition Service to plot the trend in California's average WIC food cost per participant over the period March 2010 to December 2015 using 2010$. Over this time period, the cost per participant falls from $47.47 in March 2010 to $42.37 in December 2015. The cost per participant rises over 2010 and 2011, with a large spike in August and September of 2011, when the numbers are $63.47 and $61.24,

[19]Specifically, stores with 1-2 cash registers had an MADR set at 15 percent above the average among large stores, whereas stores with 3-4 registers had an MADR set at 11 percent above the average among large stores.

[20]Further, in October 2013, the WIC program adopted a set of 19 authorization criteria that must be met to become a WIC-authorized store. These include regulations regarding health permits, adequate inventory records, minimum stocking requirements, conflicts of interest with the program, and opening hours, among others. In June 2014, WIC established new vendor peer group categories and subgroups: Category A = A-50 stores; Category B = full-line grocery stores, divided into 4 subgroups based on the number of cash registers (1-2, 3-5, 6-9, 10+); Category C = all other stores. Full-line grocery stores must meet minimum stocking requirements outlined by the WIC program. See California Department of Public Health (2015) for more details.

respectively. Note that this fast increase is driven entirely by a rise in total costs rather than a decline in participants, and appears around the time of heightened participation in WIC among small non-A-50 vendors (see further discussion in Section 3 below). The costs go back to July 2011 levels in the last three months of 2011, and then drop again in 2012, at the time of the reform. Costs per participant have steadily fluctuated around the low $40s in the time period since the reform.

Thus, it appears that the cost containment reform in California's WIC program achieved its first-order goal of lowering average food costs. In the remainder of this paper, we explore a potential unintended consequence of the reform. In particular, we examine whether the cost containment reform generated a reduction in access to benefits among the WIC-eligible population and whether some subgroups were disproportionately impacted.

3 Data

We use two main data sets in our analysis: (1) administrative data on the universe of WIC vendors from March 2010 to December 2015 from the California WIC program, and (2) restricted-use California birth records data from the California Department of Public Health.

Data on WIC vendors. The California WIC program maintains up-to-date lists of all authorized vendors, with information on the store names and addresses. These lists are periodically posted on the program's website.[21] We used an Internet archive tool called *Wayback Machine* (`http://archive.org/web/`) to access previous versions of the website, and as a result obtained unique lists of vendors from the following months: February 2012, June 2012, October 2012, November 2012, June 2013, April 2014, and June 2014.[22] We also use the list for February 2013, which we had downloaded when it was originally published. Additionally, we received lists for the months of March 2010 and January 2011, as well as weekly lists starting in November 2014 directly from two individuals who had saved them when they were originally published: Michael Amiri, chief executive at Nutricion Fundamental, Inc., a chain of A-50 stores in California, and Clyde Steele, the Chief of the

[21] See: `https://www.cdph.ca.gov/Programs/CFH/DWICSN/Pages/ResearchandData/WICVendorInfo.aspx`.

[22] The structure of the WIC program website has changed over time. To access the lists of vendors before 2015, we must use the following *url* address in the *Wayback Machine*: `http://www.cdph.ca.gov/programs/wicworks/Pages/default.aspx`. We also attempted to obtain these data directly from the California WIC program office, but were told that although they maintain current lists of authorized vendors, they do not retain past ones as they are continually written over (personal communication with Susan Sabatier, Chief of the Data Analysis, Research and Evaluation Section in WIC, 12/5/2017).

Vendor Management Branch in the California WIC program over 2009-2013.

While information on vendor names and addresses is publicly available, federal law prohibits the release of peer group information.[23] We therefore used a variety of methods to categorize the WIC vendors into three groups: large stores that likely have 5 or more cash registers, small non-A-50 stores with fewer than 5 registers, and A-50 stores. We first identified all national and regional chain stores (e.g., Albertson's, Safeway, Vons, Wal-Mart, etc.) and coded them as being "large". To classify the remaining stores, we relied on the store name and individual web searches. In particular, A-50 stores commonly have the words "Mother," "Baby," or "Nutrition" in their names, making them distinguishable from other small stores. Additionally, we relied on store websites as well as Yelp reviews and photos to obtain information on the likely number of cash registers. We also consulted with Michael Amiri and Clyde Steele with regard to our classifications. Appendix B provides more details on this process.

Figure 3a plots trends in the numbers of these three types of vendors from March 2010 to December 2015. The figure shows an increase in the number of small non-A-50 vendors in the first period of the data until a maximum of 1,904 in February 2012, followed by a marked decline to 851 in December 2015. The number of A-50 vendors drops as well, from 679 in February 2012 to 447 in December 2015. By contrast, the number of large vendors is fairly steady, ranging between 2,685 and 2,965 over the time period examined. These patterns are consistent with the fact that the MADR reform affected small non-A-50 vendors directly, A-50 stores indirectly, and large stores not at all.

Appendix Figure A.1 examines the geographic distribution of small non-A-50 vendor density across California ZCTAs in February 2012 versus December 2015. For each ZCTA in each month, we calculate the ratio of the total number of small vendors over the total population age 5 and under from 2010 Census data ($\times$ 1,000).[24] The maps show an overall decline in small vendor density in California, with particularly substantial declines in ZCTAs located in the middle of the state.

We collapse the vendor data to a ZCTA$\times$month panel using all of the available months of data, and then interpolate between months to obtain non-missing vendor information for each month between March 2010 and December 2015. For our main analysis, we use indicators for any small non-A-50 vendor and any A-50 vendor as the key explanatory variables.[25] We

[23]These regulations are located in: 7 C.F.R. §246.26(e).

[24]We trim the ratio at the 99th percentile to discard outliers in small ZCTAs.

[25]The interpolation implies that whenever a ZCTA switches from a positive number to zero vendors between non-consecutive lists, we assume that the switch happens only in the month of the next list. For example, if there is one small vendor in February 2012 and zero small vendors in June 2012, then we effectively assume that the small vendor only disappears in June 2012 and not earlier. Analogously, if a ZCTA switches from zero vendors to at least one vendor between non-consecutive lists, then we assume that the vendor

do not include an indicator for any large vendor in our main regression models because there is very little variation in the presence of a large vendor within ZCTAs over our analysis time frame.[26]

Finally, to shed light on the locations of small versus large WIC stores *within* ZCTAs, we match stores to their Census tracts and merge in data on the share of households living below the poverty line in each tract from the 2010 Census (Census Bureau, 2010).[27] If small WIC vendors are located in poorer neighborhoods within ZCTAs than large WIC vendors, then the reform may lead to an increase in distance to the nearest WIC store for households living in these areas. Indeed, we find that the average small vendor is located in a Census tract in which the poverty rate is 3.4 percentage points higher than the poverty rate of tracts with large stores in the *same* ZCTA. This difference is large when compared to the 12.8 percent average poverty rate among tracts with either small or large vendors. Thus, the reduction in small vendors following the cost containment reform leads to a decrease in the presence of WIC stores in high-poverty Census tracts in California—over our analysis time frame, the average poverty rate of Census tracts with at least one vendor falls by 0.9 percentage points. This means that, although most women have a large WIC vendor in their ZCTA even after the reform, there may still be an increase in access costs among women in the poorest neighborhoods.

California births data. The births data come from administrative records held by the California Department of Public Health. The data contain detailed information about the newborn child and the parents.[28] Importantly, these data have information about WIC

appears in the first skipped month. So, if there are no small vendors in March 2010 and one small vendor in January 2011, we assume that there is one small vendor starting in April 2010. To assess the impact of these assumptions, we examine the sensitivity of our results to only using data with non-interpolated data, finding very similar estimates.

[26]Models that include an indicator for any large vendor as an explanatory variable yield very similar results.

[27]Specifically, we use the store addresses and geocode them using three different strategies. We first geocode addresses using ArcGIS software. For the addresses that remain unmatched to map locations at the street level or more precisely, we then use Opencage geocoding software. For addresses that still remain unmatched, we then use the Census geocoder. For more information on these statistical packages, please see: `https://www.arcgis.com/index.html`, `https://opencagedata.com/api`, and `https://geocoding.geo.census.gov/`. Finally, we use Census tract boundary shapefiles from the 2010 Census to match each successfully geocoded store to its Census tract. The Census tract shapefile can be found here: `https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2010.html`. Our method results in an 86% match rate between unique WIC store addresses and Census tracts in California.

[28]The data come from two sources: medical data about the child, pregnancy, and delivery are recorded by the hospital of delivery, while information about maternal behaviors are self-reported by the mother in a questionnaire that she completes while in the hospital.

benefit receipt during pregnancy, which is our key outcome variable.[29]

The data also contain rich demographic information about the mothers, including age, education level, race/ethnicity, and nativity.[30] Importantly, the data contain the mother's (self-reported) ZIP code of residence, which allow us to match mothers to information about WIC vendor presence during their pregnancy.[31]

We calculate the estimated month and year of conception for each birth using information on the birth month and year and gestation length, and limit the data to singleton births with conceptions between March 2010 and March 2015. We then create indicators for whether mothers have access to each of the three types of vendors described above in their ZCTA in months 0 through 9 post-conception. We do not use the actual length of the pregnancy to assign WIC vendor presence as gestation length may be endogenous to WIC receipt (for more discussion on the relationship between WIC and gestation length, see, e.g.: Bitler and Currie, 2005; Joyce *et al.*, 2005; Rossin-Slater, 2013).

Table 1 shows variable means in the births data for our entire sample (column 1), and separately by mothers who do and do not have at least one small non-A-50 WIC vendor in their ZCTA of residence during the expected pregnancy period. Across most characteristics, mothers who have at least one small non-A-50 vendor during pregnancy are less advantaged than those who do not—they are less educated, more likely to be non-Hispanic black, Hispanic, and foreign-born, have worse birth outcomes, and are more likely to be covered by Medi-Cal. They are also substantially more likely to take up WIC than mothers who do not have a small non-A-50 vendor in their ZCTA. However, the difference in WIC take-up is unlikely to be entirely due to a causal effect of vendor presence, but is instead driven by the differential composition of mothers across the two groups of ZCTAs, pointing to the importance of using a research design that leverages vendor variation *within* rather than across ZCTAs.

Figures 3b, 3c, and 3d plot the share of mothers with at least one WIC store of each type (large, small non-A-50, and A-50) in their ZCTA of residence during months 0 to 9 post-conception over our analysis time period. Consistent with the minimal change in the number of large WIC vendors in Figure 3a, the share of mothers with a large vendor in

[29]These data also contain information about other maternal prenatal behaviors (e.g., smoking, weight gain, prenatal care visits), birth outcomes (child sex, birth order, plurality, birth weight in grams, gestation length in weeks, an indicator for any abnormal conditions of the newborn, and an indicator for whether the child has died by the time the birth certificate is filed), and characteristics of labor and delivery (e.g., Caesarean section delivery, any complications). Since the focus of this paper is on WIC take-up, we do not use these additional outcomes in our main analysis.

[30]We also have more limited information about the fathers. To proxy for father involvement at the time of childbirth, we create an indicator for whether the father information is missing from the birth certificate.

[31]We use a ZIP code to ZCTA crosswalk available at: `https://www.udsmapper.org/zcta-crosswalk.cfm`.

their ZCTA is quite high and relatively stable, at 92 to 93.5 percent. However, the share of mothers with at least one small non-A-50 vendor in their ZCTA drops from a maximum of 67 percent among mothers who conceived in May 2010 to a minimum of 48 percent among mothers who conceived in January 2015. The share of mothers with at least one A-50 vendor in their ZCTA also drops over the analysis time frame, from about 55 percent to about 45 percent. We explore whether this reduction in small non-A-50 and A-50 vendors (during a time of high and stable access to large vendors) influences WIC take-up in the subsequent analysis.

4 Empirical Design

As shown in Figure 3a, the cost containment reform appears to have led to a large reduction in the number of small non-A-50 vendors in California (and a somewhat smaller reduction in the number of A-50 vendors). As a consequence, mothers living in ZCTAs with at least one small vendor before the reform went into effect are substantially more likely to have had a decline in access to a small vendor than mothers in ZCTAs without a small vendor. Since the decline in vendors is arguably driven by supply-side rather than demand-side factors (i.e., the reduction in the MADR and a moratorium on new vendor applications as opposed to changes in preferences of the WIC-eligible population), we exploit within-ZCTA changes in vendor presence as a natural experiment to identify the effects of different types of vendors on WIC take-up.

Specifically, we estimate models of the form:

$$Y_{izym} = \beta_0 + \beta_1 AnyS_{zym} + \beta_2 AnyA50_{zym} + \mathbf{x}'_{izym}\gamma + \delta_z + \rho_y + \eta_m + \varepsilon_{izym} \qquad (1)$$

for each mother i residing in ZCTA z with conception year y and month m. Y_{izym} is an outcome of interest, such as an indicator for WIC receipt during pregnancy. $AnyS_{zym}$ and $AnyA50_{zym}$ are indicators for any small non-A-50 and any A-50 vendor in the mother's ZCTA of residence during months 0 to 9 post-conception, respectively.[32] The vector $\mathbf{x}_{izym}$ includes the following controls: maternal age group dummies (<20, 20-24, 25-34, 35+, missing), maternal education dummies (less than high school, high school, some college, college or more, missing), maternal race/ethnicity dummies (non-Hispanic white, non-Hispanic black, Hispanic, other race, missing), indicator for mother being foreign-born, indicator for the

[32]We have also estimated regressions using the ratios of the two types of vendors over the total population age 5 and under as the explanatory variables. It appears that any significant effects of WIC vendor presence are driven by the extensive margin (i.e., moving from zero to at least one vendor), and we therefore focus on those specifications here.

father's information being missing from the birth certificate, and parity dummies (1st, 2nd, 3rd or higher). We also include ZCTA fixed effects, δ_z, as well as fixed effects for the conception year and month, ρ_y and η_m. ε_{izym} is the error term, and we cluster standard errors at the maternal ZCTA of residence level. We are interested in the estimates of β_1 and β_2, which correspond to the impacts of having at least one small non-A-50 and at least one A-50 vendor on the outcome, respectively.

We also present results from models that add in placebo indicators for any vendors in the 9 months after the estimated month of delivery (i.e., post-pregnancy). Significant coefficients on the placebo variables would suggest that there may be trends in WIC vendor presence that confound the results.

Additionally, we estimate event-study models, in which we focus on a sample of births that are conceived in a two-year window surrounding the month of the last small WIC vendor closure in each ZCTA that experiences one. We include indicators for conceptions in three-month periods starting from 10-12 months before the closure and ending with 9-11 months after the closure; conceptions 7-9 moths before the closure (i.e., for whom most of the pregnancy was exposed to a small WIC vendor) serve as the omitted category.

Identifying assumption. Causal identification of the effects of WIC vendor presence relies on the assumption that within-ZCTA changes in vendor composition are uncorrelated with other time-varying determinants of WIC take-up. We would face a violation of this assumption if, for example, ZCTAs where small vendors exited following the cost containment reform were also experiencing differential trends in demographic or economic variables that separately impacted demand for WIC. As discussed above, to assess this possibility, we test whether there are any significant coefficients on placebo indicators for WIC vendor presence post-pregnancy (see Section 5) and examine trends in WIC take-up for conceptions in months surrounding a WIC vendor closure. We also evaluate the plausibility of the identifying assumption in two other ways.

First, Appendix Table A.1 presents estimates from a regression based on the WIC vendor data for ZCTAs that ever have at least one vendor (of any type) over our time period of analysis. For each ZCTA, we calculate the difference between the any vendor indicator of each type in February 2012 (i.e., right before the reforms went into effect) and December 2015, the last month in our data. Thus, a negative number corresponds to a decline in WIC vendor presence, while a positive number corresponds to an increase. We then regress these differences on ZCTA demographic and economic characteristics from the 2010 Census and 2011 American Communities Survey (ACS), which we parametrize as indicator variables for values above or below the sample medians. The table shows that there is little correlation

between available ZCTA characteristics and changes in vendor composition. In fact, when one considers column (3), which shows results for within-ZCTA changes in small vendor presence, there are no statistically significant associations with any of the characteristics that we consider.

Second, in Table 2, we examine the correlation between maternal characteristics in the births data and our WIC vendor variables in models with fixed effects for ZCTA, conception year, and conception month. In particular, we estimate versions of equation (1) using different maternal variables as outcomes and omitting the control variables in $\mathbf{x}_{izym}$. Out of the 18 coefficients reported in this table, only one is statistically significant at the 5% level. Moreover, when one considers the middle row with coefficients on the $AnyS_{zym}$ indicator—which accounts for most of the variation in WIC vendor presence—we see no significant or economically meaningful relationships with the maternal characteristics.

In sum, we find little evidence of confounding variation, implying that within-ZCTA changes in WIC vendor presence can be used to identify causal impacts of WIC vendors on our outcomes.

5 Results

Table 3 presents results from estimating model (1), with an indicator for WIC take-up during pregnancy as the dependent variable. In column (1), we show that among all mothers of singleton births in our analysis sample, the presence of a small non-A-50 WIC vendor in the mother's ZCTA of residence during pregnancy increases the likelihood of WIC benefit receipt by 0.8 percentage points, or 1.6 percent when evaluated at the sample mean. In columns (2) and (3), we split the sample into mothers of first-born and higher-parity children, respectively, and show that the effect on WIC take-up is entirely concentrated among first-time mothers. For these mothers, we find that within-ZCTA access to a small non-A-50 vendor increases WIC take-up by 1.4 percentage points, or 3 percent at the sample mean. In columns (4) and (5), we further separate first-time mothers into those who are born in the United States and those who are born in other countries. While we see a significant effect for both groups, the estimated increase in WIC take-up is larger both in absolute and relative terms for mothers who are foreign-born. These results are consistent with the idea that small WIC vendors reduce barriers to take-up for women who are least familiar with the program (i.e., first-time mothers) and who may face particularly high learning costs (i.e., foreign-born mothers).

Table 3 also demonstrates that there is no significant effect of within-ZCTA availability of an A-50 vendor on WIC take-up among any of the subgroups. This pattern of findings suggests that stigma—which A-50 stores are designed to reduce by catering primarily to WIC

customers—may not be a key barrier to program take-up.[33] That said, there is less within-ZCTA variation in A-50 vendor presence than in small non-A-50 vendor presence, which may limit our ability to detect significant effects of A-50 presence. In Appendix Table A.2, we address this issue by calculating the distance between the mother's ZCTA of residence and the nearest ZCTA with at least one WIC vendor of each type. For the whole sample of first-time mothers and for foreign-born first-time mothers, we find that an additional mile in distance to the nearest small non-A-50 vendor reduces the likelihood of WIC take-up by 0.03 and 0.04 percentage points, respectively. Further, it appears that distance to the nearest A-50 vendor matters for first-time foreign mothers as well—an additional mile in distance to an A-50 vendor reduces the probability of WIC receipt by 0.05 percentage points.

Table 4 presents results from regressions that also include placebo indicators for the presence of A-50 and small non-A-50 stores in the nine months post-pregnancy. None of the placebo coefficients is statistically significant, while the coefficients for the main effects of vendor presence during pregnancy are similar to those reported in Table 3.

Figure 4 shows the coefficients and 95% confidence intervals from event-study regressions for all first-time mothers in panel (a) and foreign-born first-time mothers in panel (b). These analyses use a sample of births conceived in the one year before and after the last small WIC vendor closure in each ZCTA. We find no significant differences in WIC benefit receipt between mothers who conceived in various 3-month periods *before* the small vendor closure, suggesting that the timing of exposure to the vendor during or before pregnancy does not materially predict WIC take-up. However, relative to mothers who conceive 7-9 months before the last small vendor closure, mothers who conceive *after* the last small vendor closure are significantly less likely to take-up WIC.

To assess the influence of measurement error from interpolating data on WIC vendors on our estimates, Appendix Table A.3 presents results for a sample of mothers for whom months 0 through 9 post-conception overlap with at least one month from which we have WIC vendor data. The estimates for all first-time mothers and for foreign-born first-time mothers are very similar to those presented in Table 3, suggesting that measurement error from interpolation is not a major concern.

Lastly, Table 5 presents results from estimating model (1) on a sample of mothers who have at least one large WIC vendor in their ZCTA of residence during pregnancy. We continue to see positive effects of within-ZCTA availability of small non-A-50 vendors on WIC take-up in this sample, driven by first-time and immigrant mothers. This result suggests that small

[33]It is also possible that mothers may prefer small, non-WIC-specialized stores over the A-50 ones as the former group offers a wider range of products, enabling them to do their WIC- and non-WIC shopping in one place.

vendors may be uniquely effective at reducing learning costs above and beyond other (larger) nearby stores. Further, given that small vendors tend to be located in poorer areas than large vendors in the same ZCTA, small vendors may be differentially salient and convenient for the least advantaged women in California.

6 Conclusion

The WIC program is a pillar of the U.S. social safety net that targets the health and well-being of millions of poor pregnant women and young children. While a large literature examines the impacts of WIC on infant and child health and development (Currie, 2003; Bitler and Currie, 2005; Joyce *et al.*, 2005; Lee and Mackey-Bilaver, 2007; Figlio *et al.*, 2009; Foster *et al.*, 2010; Hoynes *et al.*, 2011; Marshall *et al.*, 2013; Rossin-Slater, 2013; Edmunds *et al.*, 2014; Currie and Rajani, 2015; Metallinos-Katsaras *et al.*, 2015; Sonchak, 2016; Gregory *et al.*, 2016; Jackson and Mayne, 2016; Fingar *et al.*, 2017; Chorniy *et al.*, 2018) much less is known about the costs and benefits associated with *how* the program is administered. While the complex rules about eligible products may encourage beneficiaries to make healthier food choices, they may also serve as a barrier to subgroups with high learning costs. At the same time, while small vendors may disproportionately drive up program costs, they may also facilitate program access for subgroups who would have otherwise opted out from using the program.

We study these issues in the context of a cost containment reform in California, which targeted small vendors, and resulted in a substantial reduction in the number of such vendors serving WIC customers. We collect data on WIC vendors and link them to California birth records data. We leverage variation in the presence of different types of WIC vendors over time within a mother's ZCTA to examine how proximity to WIC vendors affects benefit take-up. Our results show that the presence of a small non-WIC-specialized vendor in the mother's ZCTA during pregnancy increases the rate of WIC benefit receipt by 0.8 percentage points (1.5 percent). The effect on take-up is driven by first-time mothers, and is larger for foreign-born than for U.S.-born mothers, suggesting that small vendors may be particularly effective at increasing access for WIC participants with high learning costs. We find a similar effect of proximity to small specialized WIC vendors for foreign-born first-time mothers, which suggests that stigma, which these stores are specifically designed to curb, is not a key barrier to take-up.

The effect of small vendors on take-up exists even if for women who are in proximity to large WIC grocers. One interpretation of this result is that the primary mechanism is not about convenience to any type of WIC store. However, we also present evidence that smaller

WIC stores are located in higher poverty Census tracts within ZCTAs than larger vendors. Given that the participation effects are concentrated among first-time users of the program, it may be that convenience costs are particularly important for this subgroup or that having a vendor within one's Census tract increases program salience and awareness. An alternative mechanism is that small stores are particularly effective in lowering the costs of learning how to differentiate between eligible and ineligible products for first-time participants, due to the smaller range of products they offer as well as the higher likelihood that they have bilingual staff. To this point, we present evidence from time-use data that first-time WIC participants spend far more time grocery shopping than individuals who are more likely to have previously used the program, as well as low-income ineligible households.

Our results have implications for understanding the trade-offs associated with cost containment and program efficiency and equity in settings where public benefits are delivered by private firms. While our estimates suggest that California's cost containment reform may have differentially reduced program access among particularly vulnerable populations, including first-time and immigrant mothers, it is important to consider how the additional funds available due to cost containment are used. If, for example, they are used for outreach and educational interventions, then they may lead to increased program access (e.g., see Aizer, 2007 for evidence on the effects of such interventions in the case of Medicaid). These questions are particularly important in light of the evidence that WIC benefit receipt is associated with improved infant health (Bitler and Currie, 2005; Figlio *et al.*, 2009; Rossin-Slater, 2013; Currie and Rajani, 2015; Sonchak, 2016; Fingar *et al.*, 2017) and the growing literature on the lasting consequences of early life conditions (Almond *et al.*, 2018; Almond and Currie, 2011; Barker, 1990). Increasing efficiency and equity in WIC would enable the program to play a bigger role in reducing disparities in early-life health and subsequent long-term and intergenerational health and human capital trajectories in the United States.

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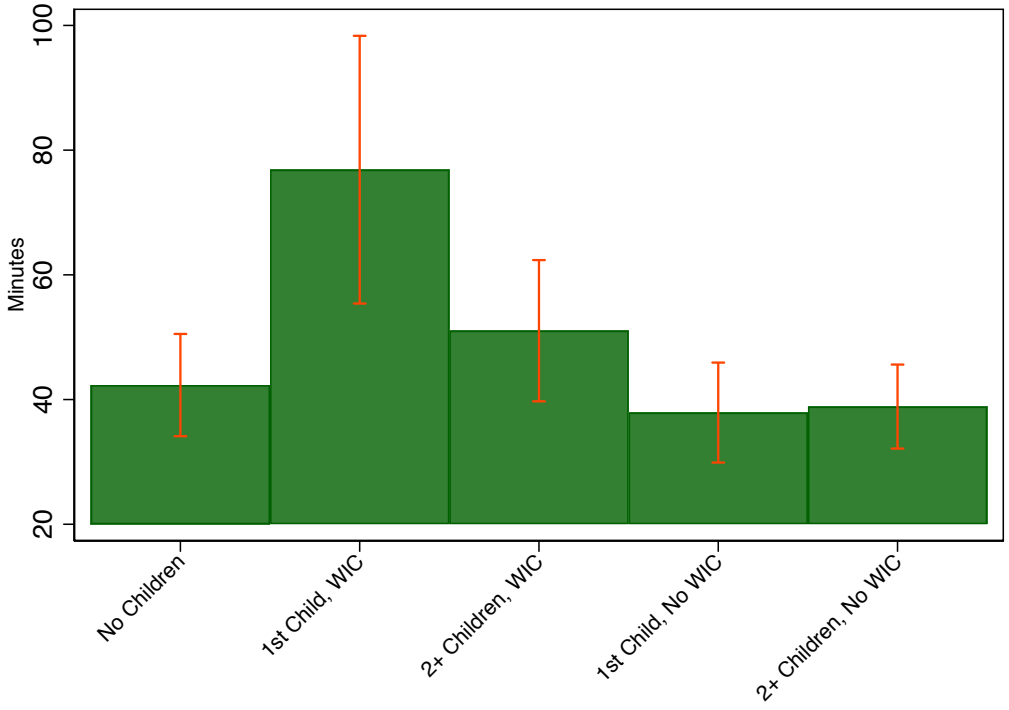
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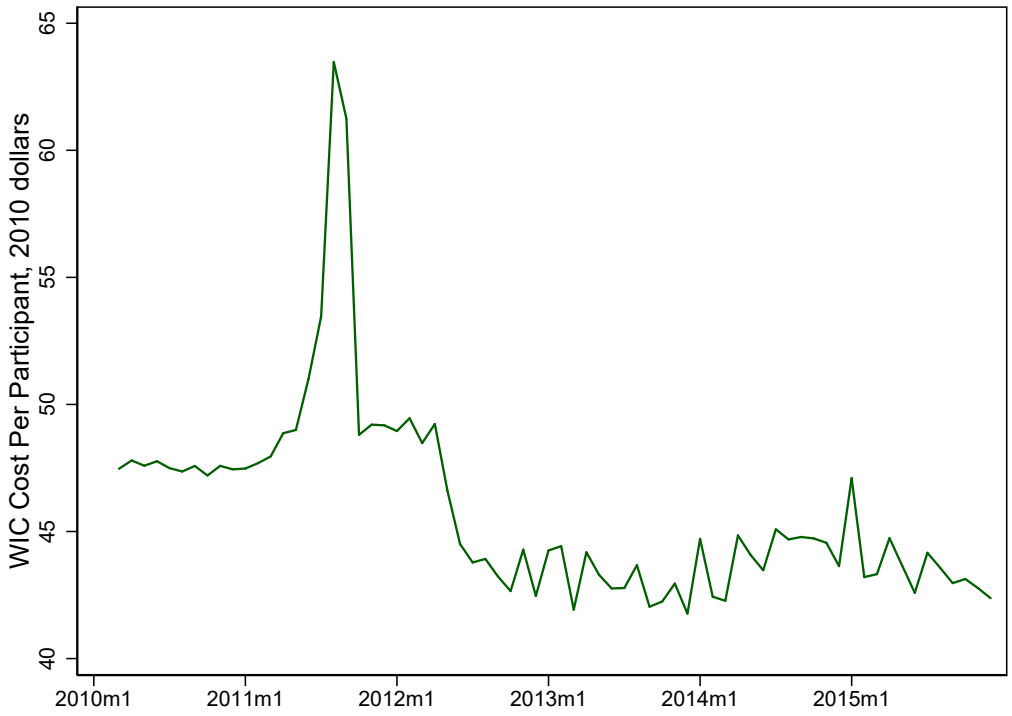
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Figure 1: Average Number of Minutes Spent Grocery Shopping, Low-Income Households



Notes: This figure plots the average number of minutes spent grocery shopping by subgroup based on data from the 2016 American Time Use Survey. The sample is restricted to households with income under 185% of the Federal Poverty Line and non-missing WIC participation information. Red bars represent 95% confidence intervals.

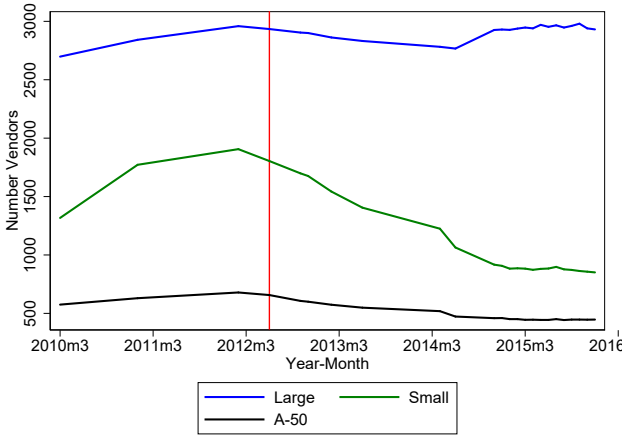
Figure 2: California WIC Food Costs Per Participant: March 2010 - December 2015



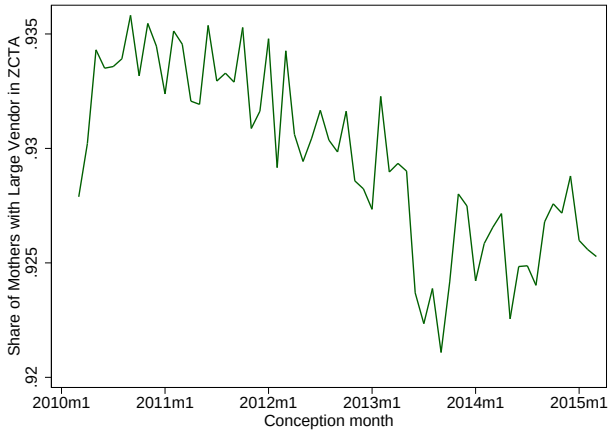
Notes: This figure shows the trend in real food costs per California WIC participant in $2010 dollars, using data from the U.S. Department of Agriculture (USDA) Food and Nutrition Service.

Figure 3: Trends in Number of WIC Vendors and Share of Mothers with a Different Types of Vendors in their ZCTA: March 2010 - December 2015

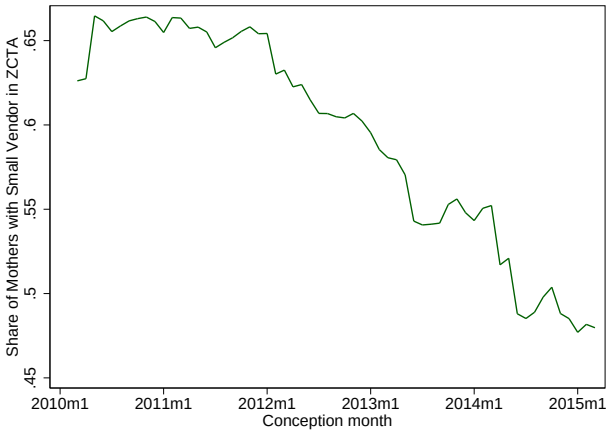
(a) Number of WIC Vendors



(b) Share of Mothers with Large WIC Vendor in ZCTA



(c) Share of Mothers with Small WIC Vendor in ZCTA



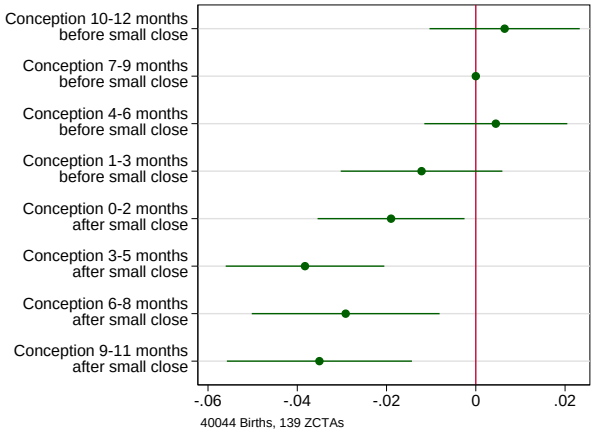
(d) Share of Mothers with A-50 WIC Vendor in ZCTA



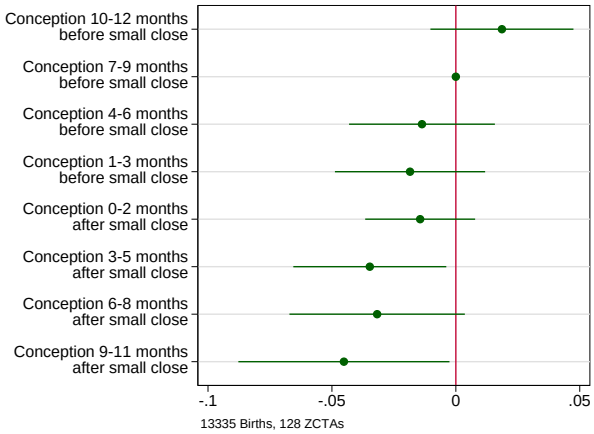
Notes: Sub-figure (a) shows the trends in the total number of WIC vendors over March 2010 - December 2015, separately by type: large stores with 5 or more cash registers, small non-A-50 stores, and A-50 stores. The data come from California WIC program administrative records on all authorized WIC vendors that in the following months: 03/2010, 01/2011, 02/2012, 06/2012, 10/2012, 11/2012, 06/2013, 04/2014, 06/2014, 11/2014, 12/2014, and every month in 2015. Sub-figures (b)-(d) show the share of mothers with at least one WIC store of the each type in their ZCTA of residence during pregnancy.

Figure 4: Event-Study Analysis Based on Timing of Small WIC Vendor Closure Relative to Conception, Firstborn Sample

(a) All Mothers, Firstborns



(b) Foreign-Born Mothers, Firstborns



Notes: These figures show the coefficients and 95% confidence intervals from event-study regressions that use a sample of births that are conceived in the one year before or after the last small WIC vendor closure in a ZCTA (i.e., births conceived in the two-year window surrounding the month when the ZCTA moves from 1 to 0 small vendors). We report the estimates on indicators for conceptions in three-month periods starting from 10-12 months before the closure and ending with 9-11 months after the closure. Conceptions 7-9 months before the closure (i.e., for whom most of the pregnancy was exposed to a small WIC vendor) serve as the omitted category.

Table 1: Births Data Variable Means by Any Small Vendor During Pregnancy, Firstborns

	All	Small vendor	No small vendor
Mother's age	26.70	25.35	28.43
Mother < high school	0.122	0.171	0.0587
Mother high school	0.236	0.284	0.176
Mother some college	0.262	0.276	0.244
Mother college +	0.340	0.232	0.478
Mother white	0.322	0.233	0.435
Mother black	0.0558	0.0681	0.0402
Mother Hispanic	0.423	0.545	0.267
Mother foreign-born	0.326	0.324	0.328
Father's info missing	0.0732	0.0913	0.0502
Birth weight (g)	3288.3	3278.3	3301.0
Low birth weight (<2500g)	0.0537	0.0560	0.0508
Gestation (weeks)	39.49	39.46	39.54
Premature (<37 weeks)	0.0659	0.0699	0.0608
Received WIC benefits	0.467	0.602	0.294
Observations	923399	517422	405977

Notes: This table shows means of births data variables, using California birth records data for all singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. Column (2) shows means for mothers who have at least one small vendor in their ZCTA of residence during months 0 through 9 post-conception. Column (3) shows means for mothers who have no small vendors in their ZCTA of residence during months 0 through 9 post-conception.

Table 2: Correlation Between Maternal Characteristics and Vendor Presence

	(1) Mother's age	(2) Mother HS or less	(3) Mother some college +	(4) Mother white	(5) Mother black	(6) Mother hispanic	(7) Mother foreign born	(8) Father's info missing	(9) Firstborn
Any Small Vendor During Pregnancy	-0.00662	0.00271	-0.00136	-0.000168	0.00111	0.00308	-0.00154	0.000673	-0.000732
	[0.0210]	[0.00219]	[0.00252]	[0.00198]	[0.000930]	[0.00235]	[0.00282]	[0.000961]	[0.00174]
Any A50 Vendor During Pregnancy	-0.0314	0.00611**	-0.00354	-0.000520	-0.000149	0.00350	-0.000868	-0.000168	-0.00223
	[0.0369]	[0.00265]	[0.00271]	[0.00207]	[0.00124]	[0.00273]	[0.00283]	[0.00118]	[0.00325]
Mean, dept. var.	28.81	0.428	0.534	0.285	0.0553	0.487	0.389	0.0612	0.393
Observations	2325911	2346723	2346723	2346723	2346723	2346723	2346723	2346723	2346723

Notes: Each column presents coefficients from separate regressions, using California birth records data for all singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. We use the following variables as outcomes: (1) Maternal age (in years), (2) Indicator for maternal education being high school or less, (3) Indicator for maternal education being some college or more, (4) indicator for mother being non-Hispanic white, (5) indicator for mother being non-Hispanic black, (6) indicator for mother being Hispanic, (7) indicator for mother being foreign-born, (8) indicator for the father's information missing from the birth certificate. All regressions include conception year, conception month, and maternal ZCTA of residence fixed effects. Standard errors clustered on the ZCTA level.

Significance levels: * p<0.1 ** p<0.05 *** p<0.01

Table 3: Effect of Vendors on WIC Take-Up, by Participant Type

	Mother Received WIC During Pregnancy				
				Mothers of Firstborns	
	(1) All	(2) 1st-Born	(3) 2+ Parity	(4) U.S.-Born	(5) Foreign-Born
Any Small Vendor During Pregnancy	0.0081*** [0.0026]	0.0143*** [0.0032]	0.00416 [0.00276]	0.0128*** [0.0034]	0.0173*** [0.0051]
Any A50 Vendor During Pregnancy	0.0038 [0.0040]	0.0033 [0.0046]	0.00411 [0.00418]	0.0017 [0.0055]	0.0079 [0.0068]
Mean, dept. var.	0.522	0.467	0.558	0.471	0.458
Observations	2,346,723	923,399	1,423,324	622,655	300,744
Pct. Change, at Mean	1.55%	3.06%	0.7%	2.72%	3.78%

Notes: Each column presents coefficients from separate regressions, using California birth records data for all singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. The dependent variable is an indicator for the mother receiving WIC benefits during pregnancy, while the key explanatory variables are indicators for any small and any A-50 vendors in the mother's ZCTA of residence during pregnancy. Columns (1)-(3) show results for all singleton births, firstborns, and higher-parity births, respectively, while columns (4) and (5) show results for U.S.-born and foreign-born mothers of firstborns, respectively. All regressions include the following control variables: maternal age group dummies (<20, 20-24, 25-34, 35+, missing), maternal education dummies (less than high school, high school, some college, college or more, missing), maternal race/ethnicity dummies (non-Hispanic white, non-Hispanic black, Hispanic, other race, missing), indicator for mother being foreign-born, indicator for the father's information being missing from the birth certificate, parity dummies (1st, 2nd, 3rd or higher), conception year, conception month, and maternal ZCTA of residence fixed effects. Standard errors clustered on the ZCTA level.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

Table 4: Effect of Vendors on WIC Take-Up, Placebo Tests

	Mother Received WIC During Pregnancy				
				Mothers of Firstborns	
	(1) All	(2) 1st-Born	(3) 2+ Parity	(4) U.S.-Born	(5) Foreign-Born
Any Small Vendor During Pregnancy	0.0082*** [0.0027]	0.0148*** [0.0034]	0.00389 [0.00280]	0.0118*** [0.00355]	0.0216*** [0.0061]
Any A50 Vendor During Pregnancy	0.0024 [0.0038]	0.00075 [0.0046]	0.00366 [0.00391]	-0.00129 [0.00528]	0.0059 [0.0075]
Any Small Vendor Post Pregnancy	-0.0001 [0.0022]	-0.0011 [0.0030]	0.000507 [0.00245]	0.00190 [0.00318]	-0.0081 [0.0050]
Any A50 Vendor Post Pregnancy	0.0026 [0.0035]	0.0048 [0.0038]	0.000844 [0.00383]	0.00561 [0.00432]	0.0042 [0.0066]
Mean, dept. var.	0.522	0.467	0.558	0.471	0.458
Observations	2,346,723	923,399	1,423,324	622,655	300,744

Notes: Each column presents coefficients from separate regressions, using California birth records data for all singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. The dependent variable is an indicator for the mother receiving WIC benefits during pregnancy. Columns (1)-(5) show results from a model that includes indicators for any small and any A-50 vendors in the mother's ZCTA of residence during pregnancy, as well as placebo indicators for any vendors in the 9 months after the estimated month of delivery (i.e., post-pregnancy), using the samples denoted in the table header. See notes under Table 3 for more details on control variables. Standard errors clustered on the ZCTA level.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

Table 5: Effect of Vendors on WIC Take-Up, Mothers in ZCTAs with Large Vendors Only

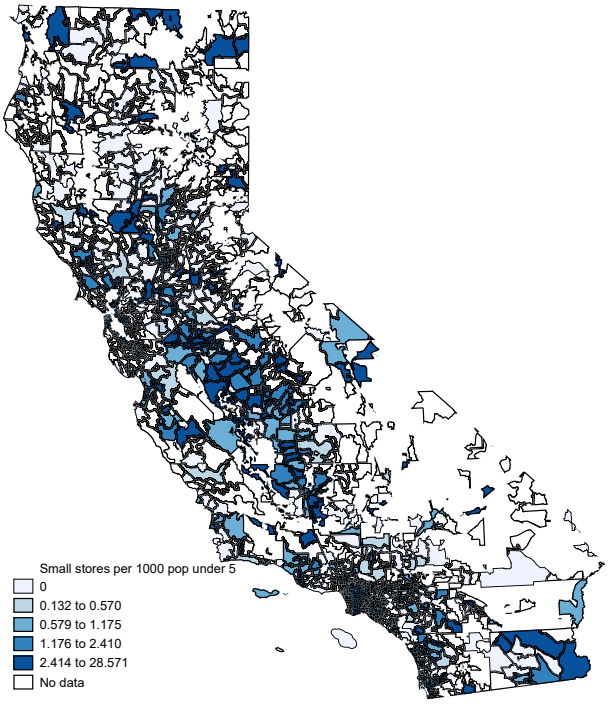
	Mother Received WIC During Pregnancy				
				Mothers of Firstborns	
	(1) All	(2) 1st-Born	(3) 2+ Parity	(4) U.S.-Born	(5) Foreign-Born
Any Small Vendor During Pregnancy	0.00830*** [0.00264]	0.0148*** [0.00324]	0.00414 [0.00286]	0.0129*** [0.00350]	0.0183*** [0.00527]
Any A50 Vendor During Pregnancy	0.00306 [0.00398]	0.00217 [0.00457]	0.00375 [0.00425]	-0.000722 [0.00520]	0.00982 [0.00690]
Mean, dept. var.	0.528	0.473	0.563	0.477	0.463
Observations	2181460	856260	1325200	575563	280697

Notes: Each column presents coefficients from separate regressions, using California birth records data for all singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. The sample is further limited to mothers residing in ZCTAs with at least one large WIC vendor open during their pregnancy. Standard errors clustered on the ZCTA level. See notes under Table 3 for more details on samples, specifications, and control variables. Standard errors clustered on the ZCTA level.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

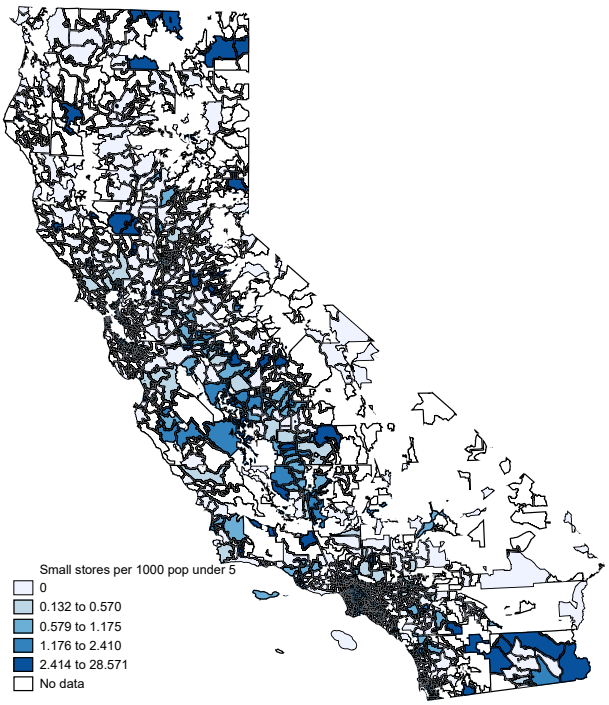
A Additional Results

Appendix Figure A.1: Geographic Distribution of Small Vendor Density: 02/2012 and 12/2015

(a) February 2012



(b) December 2015



Notes: These maps show the geographic distribution of small vendor density in February 2012 versus December 2015. For each ZCTA in each month, we calculate the ratio of the total number of small vendors over the total population under age 5 from 2010 Census data ($\times$ 1,000). We trim the ratio at the 99th percentile to discard outliers in small ZCTAs.

Appendix Table A.1: Correlation Between ZCTA Characteristics and Change in Vendor Presence Over 02/2012-12/2015

	(1) All	(2) Large	(3) Small	(4) A-50
Low Percent Pop in Labor Force	0.0118	0.0192***	0.0328	0.00743
	[0.00733]	[0.00735]	[0.0320]	[0.0242]
High Percent Pop in Poverty	-0.00460	-0.00813	0.0303	0.00880
	[0.0121]	[0.0133]	[0.0464]	[0.0321]
High Percent Pop Foreign-born	0.00328	0.0105**	0.0263	0.0520
	[0.00827]	[0.00524]	[0.0428]	[0.0418]
High Percent Pop Not Citizen	0.00479	0.00492	-0.000685	-0.0287
	[0.0106]	[0.0111]	[0.0431]	[0.0336]
High Percent Pop Not English-Speaking	-0.00888	-0.0104	-0.0219	0.0234
	[0.0124]	[0.0121]	[0.0481]	[0.0429]
High Percent Spanish-Speaking	0.0126	0.0122	-0.0977	-0.0275
	[0.0181]	[0.0139]	[0.0681]	[0.0468]
High Percent Hispanic	0.00424	-0.00301	0.0142	-0.0239
	[0.0166]	[0.0106]	[0.0660]	[0.0449]
Rural	-0.110***	-0.00297	0.00576	0.0877***
	[0.0305]	[0.0367]	[0.0529]	[0.0234]
Constant	-0.0228***	-0.0205***	-0.170***	-0.0829***
	[0.00814]	[0.00793]	[0.0270]	[0.0199]
Dept. var mean	-0.0456	-0.0135	-0.168	-0.0592
Number ZCTAs	1183	1183	1183	1183

Notes: Each column presents coefficients from separate regressions, using WIC vendor data. The units of observation are ZCTAs that ever have at least one vendor over the time period of analysis. In each column, the dependent variable is the difference between the any vendor indicator in February 2012 and December 2015, where a negative number corresponds to a decline in vendor presence, while a positive number corresponds to an increase. The explanatory variables are dummy variables for ZCTA characteristics from the 2010 Census and 2011 American Communities Survey (ACS) data, where "high" denotes a value that is at or above the sample median, while "low" denotes a value that is below the sample median. Rural ZCTAs are defined as those with less than 50% of the population living in urban areas according to the 2010 Census. The regressions are weighted by the 2010 ZCTA population, with robust standard errors.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

Appendix Table A.2: The Effects of Distance to the Nearest Vendor on WIC Take-Up, Firstborn Sample

	Mother Received WIC During Pregnancy	
	(1) All	(2) Foreign-Born Moms
Distance to Small	-0.000321***	-0.000362**
	[0.0000937]	[0.000170]
Distance to A50	-0.000144	-0.000510**
	[0.000129]	[0.000251]
Mean, dept. var.	0.467	0.458
Observations	923399	300744

Notes: Each column presents coefficients from separate regressions, using California birth records data for all firstborn singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. We calculate the distance between each mother's ZCTA of residence centroid and the centroid of the nearest ZCTA with a WIC vendor open at any time during the 9 months post-conception (of each type). Columns (1)-(2) report results from specifications that include the distance in miles to the nearest ZCTA with at least one small and one A-50 vendor, respectively. Columns (2) limits the sample to foreign-born mothers only. See notes under Table 3 for more details on the data and model specifications.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

Appendix Table A.3: The Effects of Different Types of Vendors on WIC Take-Up: Using Non-Interpolated WIC Vendor Data Only, Firstborn Sample

	Mother Received WIC During Pregnancy	
	(1) All	(2) Foreign-Born Moms
Any Small Vendor	0.00972***	0.0115***
During Pregnancy	[0.00252]	[0.00418]
Any A50 Vendor	0.00490	0.00888
During Pregnancy	[0.00368]	[0.00555]
Mean, dept. var.	0.463	0.453
Observations	835109	271286

Notes: Each column presents coefficients from separate regressions, using California birth records data for all firstborn singleton births with non-missing information on gestation length and maternal zip code of residence, and with estimated conceptions between March 2010 and March 2015. We further limit the sample to mothers for whom months 0 through 9 post-conception overlap with at least one month from which we have WIC vendor data (i.e., 03/2010, 01/2011, 02/2012, 06/2012, 10/2012, 11/2012, 06/2013, 04/2014, 06/2014, 11/2014, 12/2014, and every month in 2015). This means that we do not rely on any interpolated WIC vendor data. Column (2) limits the sample to foreign-born mothers only. See notes under Table 3 for more details on the data and model specifications.
Significance levels: * p<0.1 ** p<0.05 *** p<0.01

B Classifying WIC Vendors

As we write in Section 3, information on WIC vendor peer groups cannot be released from the program according to federal law. We took the following steps to classify the vendors in our data into three groups: large stores that likely have 5 or more cash registers, small non-A-50 stores with fewer than 5 registers, and A-50 stores.

First, we identified WIC vendors that are chain stores. We identified all large chain stores that operate in California (e.g., Wal-Mart, Target, Safeway, Lucky's, Smart & Final). We also flagged stores that have the same name but operate in multiple locations, and used any information available online (store websites, Facebook pages, Yelp pages, and Google Maps images) to determine if they were affiliated as a chain or if they were independent. If there was no information online suggesting common ownership or affiliation, we assumed they were independent stores.

Second, to determine which vendors are A-50 stores, we used any information available online to gauge whether a store specializes in WIC provisions. There are several known A-50 chains (e.g., Quickeroo, Prime Time Nutrition). Other stores have websites, Facebook pages, or Yelp pages, which indicate they primarily cater to WIC participants. For some stores, we relied on images from Google Maps: if a store had prominently displayed WIC posters or advertisements of WIC voucher receipt, we classified it as A-50. In some instances we classified stores as A-50 based on Yelp, Google, or Facebook reviews indicating that customers go to those stores primarily to redeem their WIC benefits. Lastly, we consulted with Michael Amiri and Clyde Steele to classify the remaining stores with names suggesting they specialize in WIC provisions (e.g., including the words "baby," "mother," "nutrition," etc.) but for which we could not find any information online as either A-50 vendors or not.

Third, we identified 28 commissary stores that operate as WIC vendors on military bases. These stores either have "commissary" in the name or are located on a military base. As it is unclear how these stores would have been affected by the MADR reform, we do not use them in our analysis.

Any vendors which did not fit the above three categories, as well as a few farms and farmers' markets, were classified as independent stores.

As our chain versus independent store distinction does not map perfectly to the large versus small distinction based on the number of cash registers, we next proceeded to classify the chain and independent stores as either small or large. We classified most chain stores as large, with a few exceptions: convenience store chains (e.g., EZ Mart, Value+Express, Short Stop) and small specialty store chains (e.g., 4 Way Meat Market, Doc's Meat Market) were classified as small stores.

Finally, we conducted Google searches for each independent vendor, and we classified as large any vendor which had images on its website, Yelp or Facebook page, or Google Maps indicating at least 5 cash registers. Also, independent stores which appeared to be major anchor stores in strip malls were classified as large. However, most independent stores were classified as small.