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The Economic Impacts of Breastfeeding: A Focus on USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Victor Oliveira, Mark Prell, and Xinzhe Cheng





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Victor Oliveira, Mark Prell, and Xinzhe Cheng

Abstract

In March 2018, Congress directed USDA’s Economic Research Service to report on the economic benefits of breastfeeding, including its potential cost savings for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Medicaid. As a result of that directive, this study examined the effects of a hypothetical increase in breastfeeding rates among WIC participants from their 2016 levels to medically recommended levels. The study defined medically recommended levels as 90 percent of infants are exclusively breastfed for their first 6 months, followed by continued breastfeeding with the addition of complementary foods—but not infant formula—for the next 6 months. Results indicate that the number of mothers who participated in WIC that year would have increased by an estimated 646,000 per month, an 8-percent increase in the total number of WIC participants. WIC program costs would have risen by an estimated \$252.4 million, or 4.2 percent of total costs in 2016. As a result of health benefits associated with breastfeeding, Federal Medicaid costs would have decreased by at least \$111.6 million, resulting in an estimated increase of \$140.9 million in combined Federal WIC and Medicaid costs. On the other hand, health-related cost savings that accrue to WIC households or their health insurance providers would have totaled \$9.0 billion (excluding the savings that accrue to the Federal portion of Medicaid). Holding other factors constant, if the hypothetical increase in breastfeeding rates was sustained for future years, these estimated values for 2016 would represent cost impacts that recur each year.

Keywords: Breastfeeding; Special Supplemental Nutrition Program for Women, Infants, and Children; WIC; food package costs; Medicaid; health-related costs.

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The authors would like to thank David Smallwood, formerly with USDA, Economic Research Service (ERS), for contributions to the study’s design and staff from the Centers for Disease Control and Prevention for breastfeeding data. We also thank the following individuals for technical peer reviews: Patrick McLaughlin, USDA, ERS; Kelley Scanlon, USDA, Food and Nutrition Service; Alison Jackowitz, American University; and Harry Zhang, Old Dominion University. Thanks also to John Weber and Cynthia A. Ray, USDA, ERS, for editorial and design services.

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The Economic Impacts of Breastfeeding: A Focus on USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

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What Is the Issue?

Breastfeeding rates in the United States—in particular for duration and exclusivity—fall short of those recommended by the American Academy of Pediatrics (AAP) and other U.S. health organizations. Breastfeeding rates among participants in USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) are particularly low. In March 2018, Congress directed USDA's Economic Research Service (ERS) to conduct a study on the economic benefits of breastfeeding, including its potential cost savings for WIC and Medicaid. This report addresses the congressional directive by estimating the effects that increased breastfeeding rates (up to levels recommended by AAP) in WIC would have on: (1) the number of participants in WIC; (2) costs to WIC; (3) costs to Medicaid; and (4) health-related costs that accrue to WIC households or their health insurance providers; reductions in such costs represent a benefit or cost saving. To quantify these effects, costs based on estimated breastfeeding rates in 2016 were compared to projected costs if breastfeeding rates in WIC hypothetically reached "medically recommended" levels, defined in this study as 90 percent of infants are exclusively breastfed for their first 6 months, followed by continued breastfeeding with the addition of complementary foods—but no infant formula—for the next 6 months.

What Did the Study Find?

Results from this study indicate that if breastfeeding rates in WIC in 2016 rose to recommended levels:

- The number of mothers who participated in WIC would have increased by an average 645,811 per month in 2016, an 8-percent increase in total WIC participants.
- Costs to WIC would have increased by \$252.4 million, or 4.2 percent of WIC's total cost in 2016. Although total food package costs would have decreased by \$33.8 million, costs for Nutrition Services and Administration (NSA)—which include breastfeeding promotion and support activities—would have increased by \$286.2 million.
- Reductions in the incidence of various diseases due to increased breastfeeding among WIC participants would have reduced health-related costs to WIC households or their private and Government health insurance providers. For example, increased breastfeeding rates would have decreased the Federal portion of Medicaid costs by at least \$111.6

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million. As a result, Federal program costs to WIC and Medicaid combined would have increased by an estimated \$140.9 million.

- Total health-related costs would have been reduced by \$9.1 billion (including savings to Medicaid). Over three-quarters (\$6.9 billion) of the health-related cost savings would have resulted from reductions in early deaths. The rest would be due to savings in medical costs (\$1.5 billion) and nonmedical costs (\$635 million).
- Excluding the \$111.6 million in savings that accrue to the Federal portion of Medicaid, the health-related cost savings to WIC households or their health insurance providers would have totaled \$9.0 billion.

Holding other factors constant, if the hypothetical increase in breastfeeding rates was sustained for future years, these estimated values for 2016 would represent recurring costs each year.

To address uncertainty around the estimates of programmatic and health-related costs, the study also estimates effects under several different scenarios whereby hypothesized breastfeeding rates increased but by less than recommended levels. The results indicate that WIC participation, WIC program costs, and Federal program costs to WIC and Medicaid combined would increase, while health-related costs to WIC households or their insurers would decrease, but by less than if breastfeeding rates increased to medically recommended levels. The magnitude of these effects varies depending on the degree to which the breastfeeding rates increase and the ratio of fully breastfeeding to partial breastfeeding participants.

A unique feature of this study is that it examines the economic impacts of increased breastfeeding rates in WIC from the perspectives of different parties—the WIC program, the Medicaid program, and WIC households or their health insurance providers. However, the study did not estimate the repercussions of increased breastfeeding on several markets that would be directly affected. For example, if breastfeeding rates reached medically recommended levels, infant formula usage would decrease with potential negative implications for infant formula manufacturers, which could in turn affect the size of the infant formula rebates that manufacturers provide to WIC and, therefore, affect costs to WIC. The study also did not consider the additional financial investments that would be needed to achieve medically recommended breastfeeding levels. Breastfeeding promotion and support efforts—by entities such as WIC, other Government agencies, health care providers, private insurers, employers, and other organizations—would likely have to be scaled up considerably to reach medically recommended breastfeeding levels in WIC.

How Was the Study Conducted?

The analysis of the effect of increased breastfeeding rates on WIC participation and program costs used WIC administrative data from USDA's Food and Nutrition Service (FNS) supplemented with data obtained from research reports by FNS and the National Academies of Sciences, Engineering, and Medicine. The analysis of the effect of increased breastfeeding rates on health-related savings used the Breastfeeding Savings Calculator developed by the U.S. Breastfeeding Committee—an independent nonprofit organization. Data on breastfeeding rates came from the Centers for Disease Control and Prevention's (CDC) National Immunization Survey (NIS).

The Economic Impacts of Breastfeeding: A Focus on USDA’s Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

Introduction

Breastfeeding is widely acknowledged to be the preferred method of feeding infants, conferring a number of health benefits upon both infant and mother. Furthermore, the protective effects of breastfeeding increase when breastfeeding is exclusive (i.e., no solids or liquids other than human milk) and when it is maintained for longer periods. In its policy statement on *Breastfeeding and the Use of Human Milk*, the American Academy of Pediatrics (AAP) recommends “exclusive breastfeeding for about 6 months, followed by continued breastfeeding as complementary foods are introduced, with continuation of breastfeeding for 1 year or longer as mutually desired by mother and infant” (American Academy of Pediatrics, 2012, p. e827). Other notable U.S. health organizations such as the Academy of Nutrition and Dietetics (2015), the American Public Health Association (2007), the American Academy of Family Physicians (no date), and the American College of Obstetricians and Gynecologists (2016) also recommend exclusive breastfeeding for 6 months and continued breastfeeding for at least an additional 6 months.

Because it improves health, breastfeeding is also associated with a number of economic benefits, both direct and indirect. Direct economic benefits result when better infant and maternal health from breastfeeding leads to lower medical costs by reducing physician fees, hospital costs, prescription drugs, medical supplies, etc. Indirect economic benefits result when improved health from breastfeeding reduces parents’ lost wages from missed work. Another type of indirect economic benefit (based on the value of statistical life) results from fewer early deaths.

Despite the health and economic benefits associated with breastfeeding, breastfeeding rates in the United States—in particular for duration and exclusivity—fall short of those recommended by AAP and others. (See box “Breastfeeding Rates by Age of Infant.”) By closing the gap between current and recommended breastfeeding rates, society can potentially realize economic benefits.

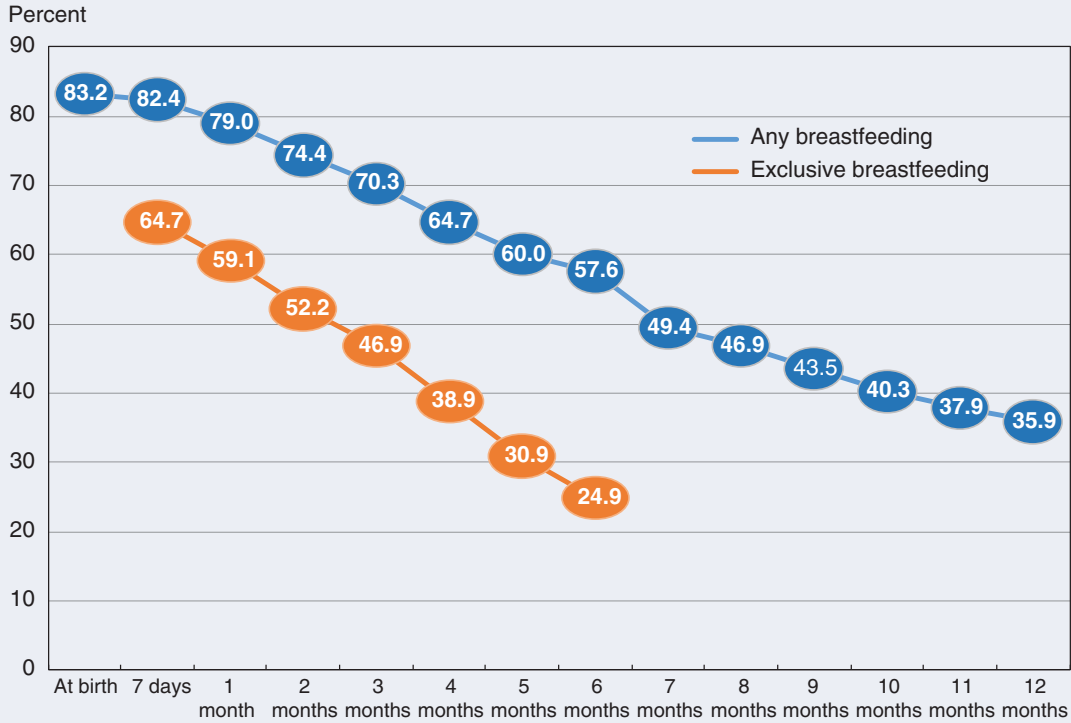
Research on the economic impacts associated with increased breastfeeding rates is necessary to fully understand the financial effects of breastfeeding (U.S. Department of Health and Human Services, 2011, p. 32). A path-breaking study on the economic benefits of breastfeeding conducted by USDA’s Economic Research Service (ERS) in 2001 estimated that a minimum of \$3.6 billion in 1998 dollars would be saved annually if the prevalence of exclusive breastfeeding were increased to levels recommended by the Surgeon General (Weimer, 2001). That study focused on medical costs associated with three infant diseases and also included indirect costs such as wages lost while caring for a sick child. A 2010 study by Bartick and Reinhold, which added additional pediatric diseases to the analysis, estimated that the United States would save \$13 billion a year (including \$2.2 billion in direct medical costs) in 2007 dollars if 90 percent of families breastfed their infants exclusively for 6 months.

Breastfeeding Rates by Age of Infant

Among infants born in the United States in 2015, an estimated 83.2 percent were initially breastfed. (See box figure.) However, as the infants aged, the prevalence of breastfeeding decreased sharply. For example, by 6 months only 57.6 percent of the infants were breastfed and just 35.9 percent were still breastfed by 12 months. As infants age, exclusive breastfeeding dropped off at an even faster rate than any breastfeeding.¹

Box figure 1

Rates of any and exclusive breastfeeding by age among children born in 2015



Source: USDA, Economic Research Service using National Immunization Survey (NIS), Centers for Disease Control and Prevention.

¹The Centers for Disease Control and Prevention (CDC) define exclusive breastfeeding as only breast milk—no solids, water, or other liquids (U.S. Department of Health and Human Services, no date, c). This definition of exclusivity results in the absence of exclusive breastfeeding monitoring after 6 months of age, at which time the introduction of complementary (i.e., solid) foods are recommended (American Academy of Pediatrics, 2012).

The Surgeon General's Call to Action to Support Breastfeeding in 2011 appealed for additional economic analysis on breastfeeding, stating that “current and comprehensive economic studies that more precisely estimate the complete cost-benefit ratio of breastfeeding and related activities are critical to inform policy making” (U.S. Department of Health and Human Services, 2011, p. 33). Recently, a landmark study by Bartick et al. (2017) extended the previous work on the economic impacts of breastfeeding by examining the economic effects of increased breastfeeding rates on mothers as well as infants, by using more recent data on breastfeeding rates, and by lengthening the time horizon to estimate long-term effects in addition to short-term effects. They estimated that the societal cost of suboptimal breastfeeding in the United States totaled at least \$18.5 billion in 2014 dollars, of which \$3.0 billion were direct medical costs.

Noting that “public health investments must be justified by analyses that demonstrate economic value for society as a whole, for health care institutions, or for purchasers of care,” the Call to Action also asserted that “more precise information is needed on who will benefit” from the costs savings associated with increased breastfeeding (U.S. Department of Health and Human Services, 2011, p. 54). Generally, low-income mothers breastfeed at lower rates than higher income mothers (U.S. Department of Health and Human Services, no date, d). Based on the premise that early intervention during critical times of growth and development can help prevent future medical and developmental problems, USDA’s Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides supplemental foods, nutrition education, and referrals to health and social services, along with breastfeeding support to low-income, nutritionally at-risk pregnant, breastfeeding, and postpartum women, infants, and children up to age 5. WIC has a long reach, serving almost 1.9 million infants per month in 2016, or nearly half (48 percent) of all U.S. infants, and 1.1 million postpartum women per month, or over one-quarter (28 percent) of all postpartum women.²

Breastfeeding rates among infants participating in WIC have been increasing since the 1990s (Thorn et al., 2018). However, they remain below those of other low-income infants, making WIC infants and mothers especially vulnerable to the health-related consequences of low breastfeeding (U.S. Department of Health and Human Services, no date, d). WIC has made breastfeeding promotion and support a priority. (See box “Breastfeeding Promotion and Support Activities in the WIC Program.”)

In recognition of the preventive impact of breastfeeding on infant and maternal health, and the important role of WIC in encouraging breastfeeding, the U.S. Senate Committee on Appropriations in March 2018 directed ERS to conduct a study on the economic benefits of breastfeeding:

²The percentage of infants participating in the program was estimated by dividing the average monthly number of infants participating in WIC in FY 2016 (1,875,706 from USDA, no date, a) by the number of births in the United States in calendar year 2016 (3,945,875 from Martin et al., 2018). The percentage of postpartum women participating in the program was estimated by summing the average monthly number of breastfeeding women participating in WIC in FY 2016 (592,384 from USDA, no date, a) and the average monthly number of nonbreastfeeding postpartum women in WIC in 2016 (592,384 from USDA, no date, a) and dividing it by the number of births in 2016 (3,945,875 from Martin et al., 2018), which served as the proxy for the number of postpartum women in 2016. Note that the denominator consists of all postpartum women (up to 1 year after birth) in the United States, while the numerator consists of all breastfeeding women in WIC (up to 1 year after birth) and all nonbreastfeeding postpartum women in WIC (up to 6 months after birth).

Breastfeeding Promotion and Support Activities in the WIC Program

Administered by USDA's Food and Nutrition Service (FNS), the Special Supplemental Nutrition Program for Women, Infants, and Children's (WIC) mission is to safeguard the health of low-income, nutritionally-at-risk pregnant, breastfeeding, and postpartum women as well as infants and children up to age 5. To be eligible on the basis of income, applicants must have annual household income at or below 185 percent of the Federal poverty guidelines (\$46,435 for a family of four in July 2018). A person who participates or who has certain family members who participate in other benefits programs, such as the Supplemental Nutrition Assistance Program (SNAP), Medicaid, or Temporary Assistance for Needy Families (TANF), automatically meets the income eligibility requirement.

Federal regulations require that all pregnant WIC participants be "encouraged to breastfeed unless contraindicated for health reasons" (CFR 7. 246.11). WIC State agencies are also required to spend a specified amount (\$37.93 in FY 2017), adjusted annually for inflation, on each pregnant and breastfeeding woman in support of breastfeeding (USDA, 2016, a). WIC State agencies are required to hire a breastfeeding promotion coordinator and educate local staff on the benefits of breastfeeding. WIC, through its nutrition education and breastfeeding promotion programs, educates women on the benefits of breastfeeding. Two-thirds of local WIC agencies operate a breastfeeding peer counseling program (Forrestal et al., 2015). Some breastfeeding mothers also receive breast pumps and other breastfeeding aids to help support the initiation and continuation of breastfeeding. Breastfeeding promotion and support activities in WIC totaled about \$159 million in FY 2016 (USDA, 2017, a).

WIC offers three different food packages for mothers and infants based on breastfeeding status: fully breastfed, partially breastfed, and fully formula fed. Women who fully breastfeed their infants receive an enhanced food package containing additional foods and larger quantities of other foods. Partial breastfeeding women, while receiving smaller amounts of food than fully breastfeeding women, receive larger amounts of food than fully formula-feeding women. Fully and partially breastfeeding women are also eligible to participate in WIC longer than fully formula-feeding women.

Once infants reach 6 months of age, those who are fully breastfed receive twice the quantity of infant fruits and vegetables as those who are partially breastfed or fully formula fed. Unlike partially breastfed or fully formula-fed infants, fully breastfed infants also receive infant meats after 6 months of age. To encourage the successful initiation of breastfeeding, WIC does not routinely provide formula to partially breastfed infants in their birth month.

If limited funds prevent WIC from serving all eligible applicants, a priority-based system in place ensures that program benefits reach those individuals with the greatest nutritional risk and those who are most likely to benefit from WIC intervention. In general, priority is given to people demonstrating medically based nutritional risks (such as anemia) over dietary nutritional risks, to infants and pregnant and breastfeeding women over children, and to children over nonbreastfeeding women. A breastfeeding mother and her infant are placed in the highest priority level for which either is qualified.

“The Committee recognizes the important role of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in encouraging breastfeeding. Breastfeeding can be an important preventive measure in infant and maternal health, and WIC offers multiple services and supports to mothers to help achieve optimal breastfeeding. As Congress looks for ways to reduce Federal health care spending, it is important to understand the preventive impact of breastfeeding and WIC’s initiatives within broader health care spending. The Committee requests within 12 months an updated study from the ERS on the economic benefits of breastfeeding, including its potential cost savings for Medicaid and the WIC program. (Senate Report 115-131)” (USDA, 2018, p. 14).

In response to the congressional directive, this study adds to the literature on the economic effects of breastfeeding by examining the potential cost savings of breastfeeding on the WIC and Medicaid programs.³ The study also examines the potential health-related cost savings resulting from increased breastfeeding that accrue to WIC households or their health insurance providers.

A unique feature of this study is that it examines the economic impact of increased breastfeeding rates in WIC from the perspectives of different parties—the WIC program, the Medicaid program, and WIC households or their health insurance providers. Altogether, the study has five main objectives:

1. *Examine trends in breastfeeding rates at the national level and in WIC.* Breastfeeding rates of WIC participants are below the national average and are of special interest.
2. *Estimate the change in the number of program participants if breastfeeding rates in WIC met levels recommended by AAP.* Participating in the program benefits individuals as well as society through improved health and nutrition of vulnerable members.
3. *Estimate the change in costs to the WIC program if breastfeeding rates in WIC met levels recommended by AAP.* As USDA’s largest discretionary grant program, WIC can only serve as many participants as its federally allocated budget allows.⁴ As a result, factors affecting cost are especially important to the program, in addition to American taxpayers.
4. *Estimate the effect on Medicaid costs attributed to increased breastfeeding rates among WIC participants.* The public provides support for health care to low-income people through the Medicaid program. Savings on health care costs from increased breastfeeding among WIC participants has the potential for reducing Medicaid expenditures.
5. *Estimate the health-related cost savings associated with increased breastfeeding rates among WIC participants.* It is important to understand the full impact of increased breastfeeding rates in WIC, including those effects that extend beyond the WIC and Medicaid budgets.

³The U.S. House of Representatives in 2018 also called for a report on the economic impacts of breastfeeding. Specifically, House Report 115-232 directed “ERS to update its 2001 Jon Weimer study of the economic benefits of breastfeeding and make it publically accessible within 12 months of enactment of this Act” (USDA, 2018, p. 14). The study by Bartick et al. (2017) updated the Weimer (2001) study, in effect satisfying the House’s directive.

⁴In contrast, USDA’s largest food and nutrition assistance program—the Supplemental Nutrition Assistance Program (SNAP—formerly the Food Stamp Program)—operates as an entitlement program whereby everyone who meets the eligibility criteria may receive benefits if they choose.

Breastfeeding Trends

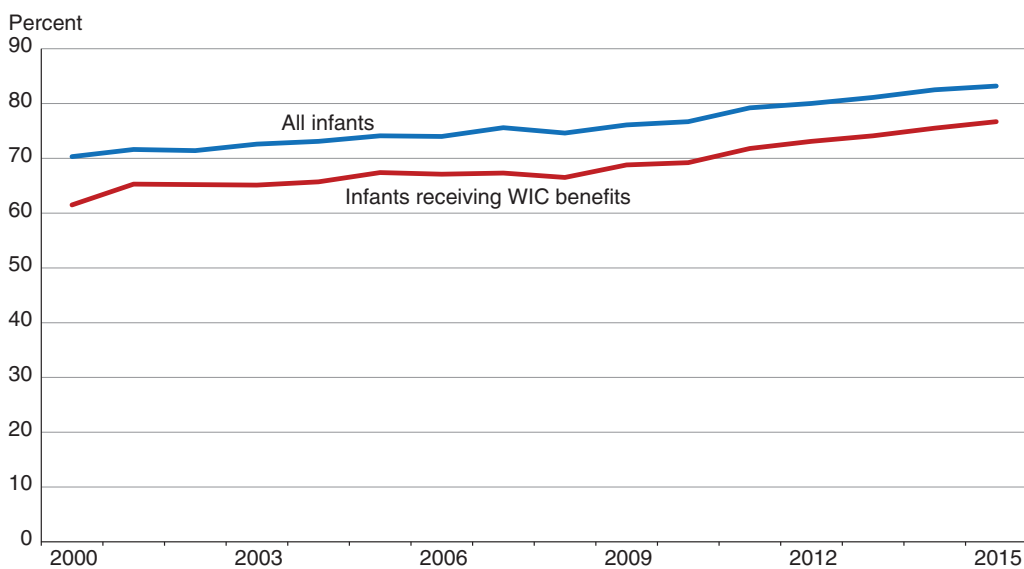
The U.S. Department of Health and Human Services (DHHS) has made increasing breastfeeding a national priority health objective. Its *Healthy People 2020*, a set of objectives for improving the health of Americans, includes 10-year goals based on the initiation, duration, and exclusivity of breastfeeding (U.S. Department of Health and Human Services, no date, e). DHHS's Centers for Disease Control and Prevention (CDC) conducts the National Immunization Survey (NIS) that includes questions on breastfeeding that are used to monitor breastfeeding rates at both national and State levels by birth year and track the Nation's progress toward achieving the Healthy People 2020 breastfeeding goals. Each year, the NIS surveys families with infants ages 19-36 months and asks retrospectively about breastfeeding (U.S. Department of Health and Human Services, no date, b).⁵ This chapter uses data from the NIS, which first began collecting breastfeeding data in 2000, to examine breastfeeding trends.

National Breastfeeding Trends

National breastfeeding initiation rates increased from 70 percent in 2000 to 83 percent in 2015 (the latest year of available data): an 18-percent increase (fig. 1). Breastfeeding rates by duration have followed the same general increasing trend as breastfeeding initiation rates since the early 2000s (fig. 2). (See box "Barriers to Continued Breastfeeding.") Among children born in 2015, 58 percent were breastfed at 6 months compared to 35 percent among children born in 2000, and 36 percent were breastfed at 12 months in 2015 compared to 16 percent among children born in 2000.

Figure 1

Breastfeeding initiation rates for all U.S. infants and infants receiving WIC benefits, 2000-15

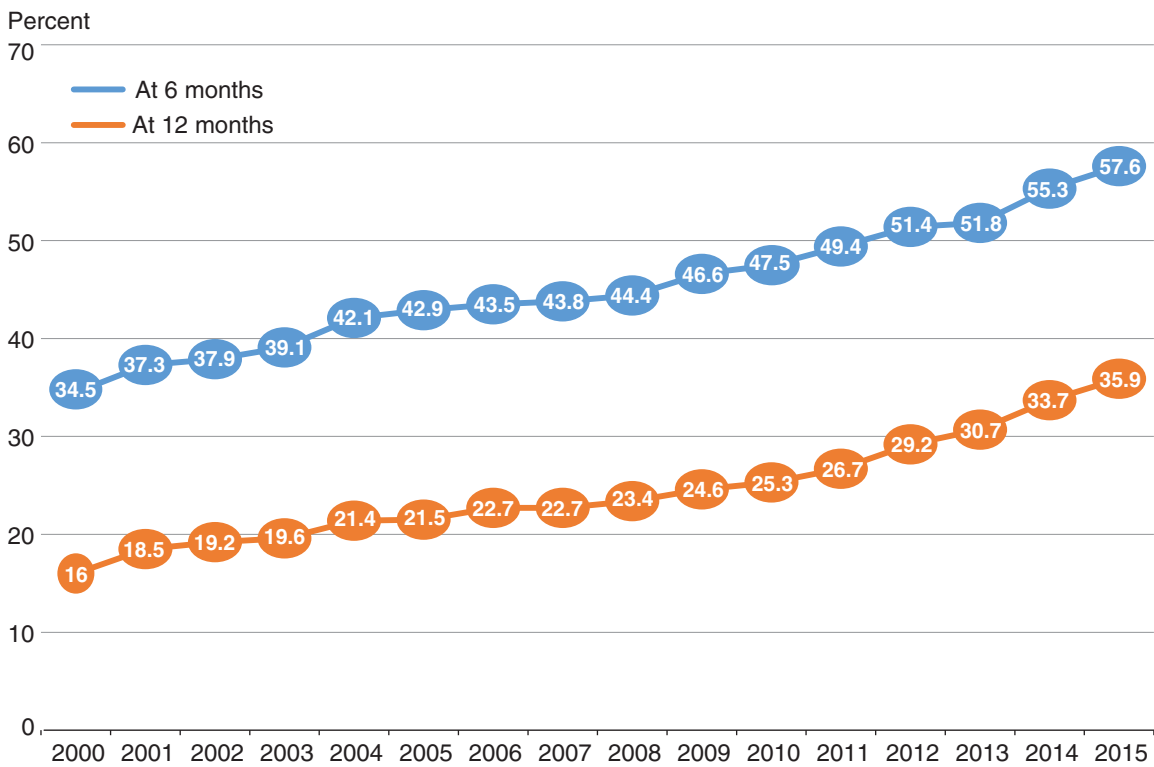


Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service using National Immunization Survey (NIS), Centers for Disease Control and Prevention.

⁵Information on breastfeeding practice collected from maternal recall where mothers are asked to recall their practices from years earlier may raise concerns about the accuracy of the data. A review of studies of the validity and reliability of maternal recall of breastfeeding practice concluded that maternal recall is a valid and reliable estimate of breastfeeding initiation and duration, especially when the duration of breastfeeding is recalled after a short period of 3 years or less (Li et al., 2005).

Figure 2
Breastfeeding rates at 6 and 12 months, 2000-15



Source: USDA, Economic Research Service using National Immunization Survey (NIS), Centers for Disease Control and Prevention.

Rates of exclusive breastfeeding have also increased since 2003 (fig. 3).⁶ For infants born in 2015, 47 percent were exclusively breastfed through 3 months (up from 30 percent in 2003), and 25 percent were exclusively breastfed through 6 months (up from 10 percent in 2003).

Overall rates of breastfeeding mask important disparities in breastfeeding rates by socio-demographic characteristics (Li et al., 2005, and Anstey et al., 2017). For example, among children born in 2015, rates of any breastfeeding were statistically significantly above the national average for non-Hispanic Whites and non-Hispanic Asians; for infants that were ineligible for WIC; for infants with mothers who were married or college graduates; and for infants from households with income-to-poverty ratios of 200-399, 400-599, or 600 percent or greater (fig. 4). On the other hand, breastfeeding rates were significantly below the national average for non-Hispanic Blacks; for infants with unmarried mothers and mothers with a high school education or less; for infants from households with an income-to-poverty ratio of less than 100 percent; and for infants participating in WIC.

⁶Breastfeeding rates by exclusivity based on NIS data are not available prior to 2003.

Barriers to Continued Breastfeeding

Although over four in five infants in the United States are breastfed initially, only slightly more than half are breastfed at 6 months, and only one-third are still breastfed at 12 months. Research has identified a number of possible barriers to continued breastfeeding, including:

Breastfeeding difficulties

Among the reasons cited by mothers as factors leading to early cessation of breastfeeding are difficulty breastfeeding, including trouble latching, pain while breastfeeding, and/or perceived insufficient milk supply (Kirkland and Fein, 2003; Li et al., 2008; Haughton et al., 2010; Ahluwalia et al., 2005; and May et al., 2017). Stuebe et al. (2014) estimated that one in eight mothers who initiated breastfeeding experienced early, undesired weaning that they self-reported was due to lactation dysfunction.

Work

Work outside the home is another significant barrier to continued breastfeeding (Haider et al., 2003; Kimbro, 2006; and Haughton et al., 2010). Fein and Roe (1998) found that full-time work is less favorable to duration of breastfeeding than part-time work. Type of employment may also affect duration of breastfeeding. For example, Kimbro (2006) found that mothers with professional jobs—who presumably have a more flexible work situation—breastfeed longer than mothers in most other types of jobs. Other work-related barriers include the lack or shortness of maternity leave (Roe et al., 1999). Since most employed breastfeeding women must express milk while at the workplace, the workplace environment can affect duration. For example, the Centers for Disease Control and Prevention cites concerns about lack of support from employers and colleagues among possible barriers in the workplace (Shealy et al., 2005). As of 2010, the Fair Labor Standards Act requires employers (with some exemptions) to provide a nursing mother reasonable break time and a private space, other than a bathroom, to express breast milk for 1 year after the birth of her child (29 U.S.C. 207).

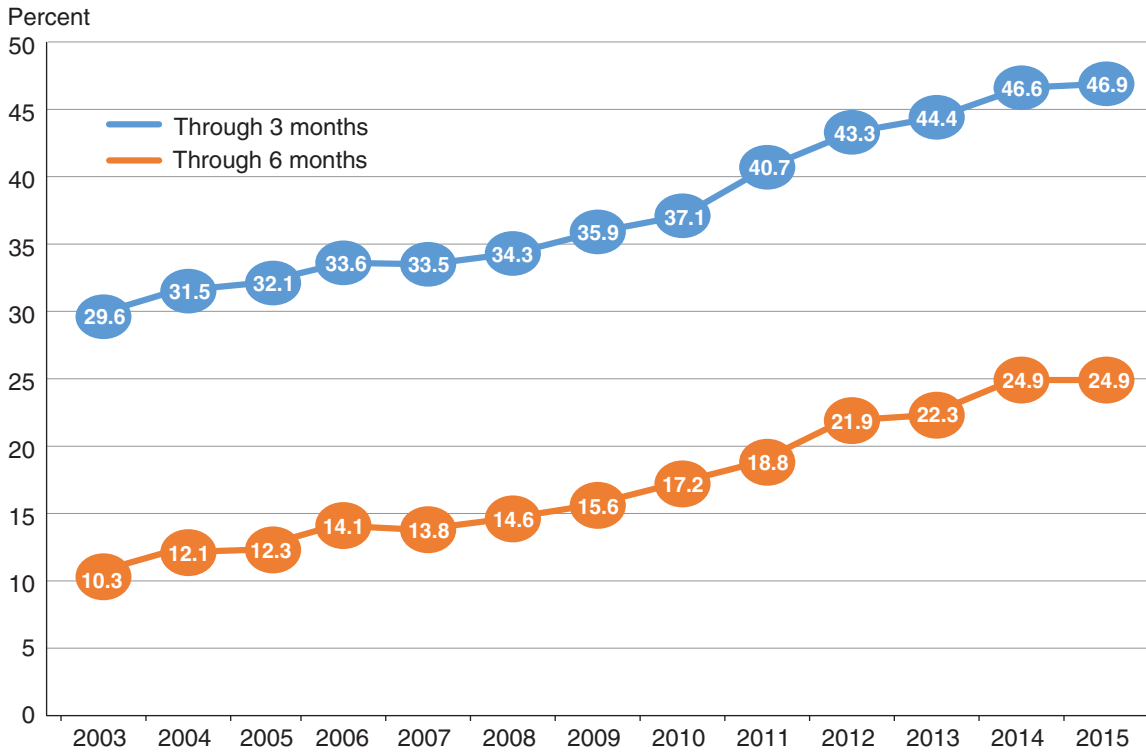
Lack of social support

Negative attitudes of fathers, other family members, and friends toward breastfeeding can influence mothers' decision to breastfeed (U.S. Department of Health and Human Services, 2011), as can lack of encouragement from the infant's doctor (May et al., 2017). Embarrassment about nursing in public can also negatively affect breastfeeding (U.S. Department of Health and Human Services, 2011).

Environmental factors

Studies by Rosenberg et al. (2008) and Langellier et al. (2014) suggest that hospitals may impact the decisions of mothers to continue to breastfeed through the gift baskets (containing formula, coupons for formula, and new bottles) provided to mothers upon hospital discharge. The marketing of infant formula as a substitute for breastmilk may also contribute to the early discontinuation of breastfeeding.

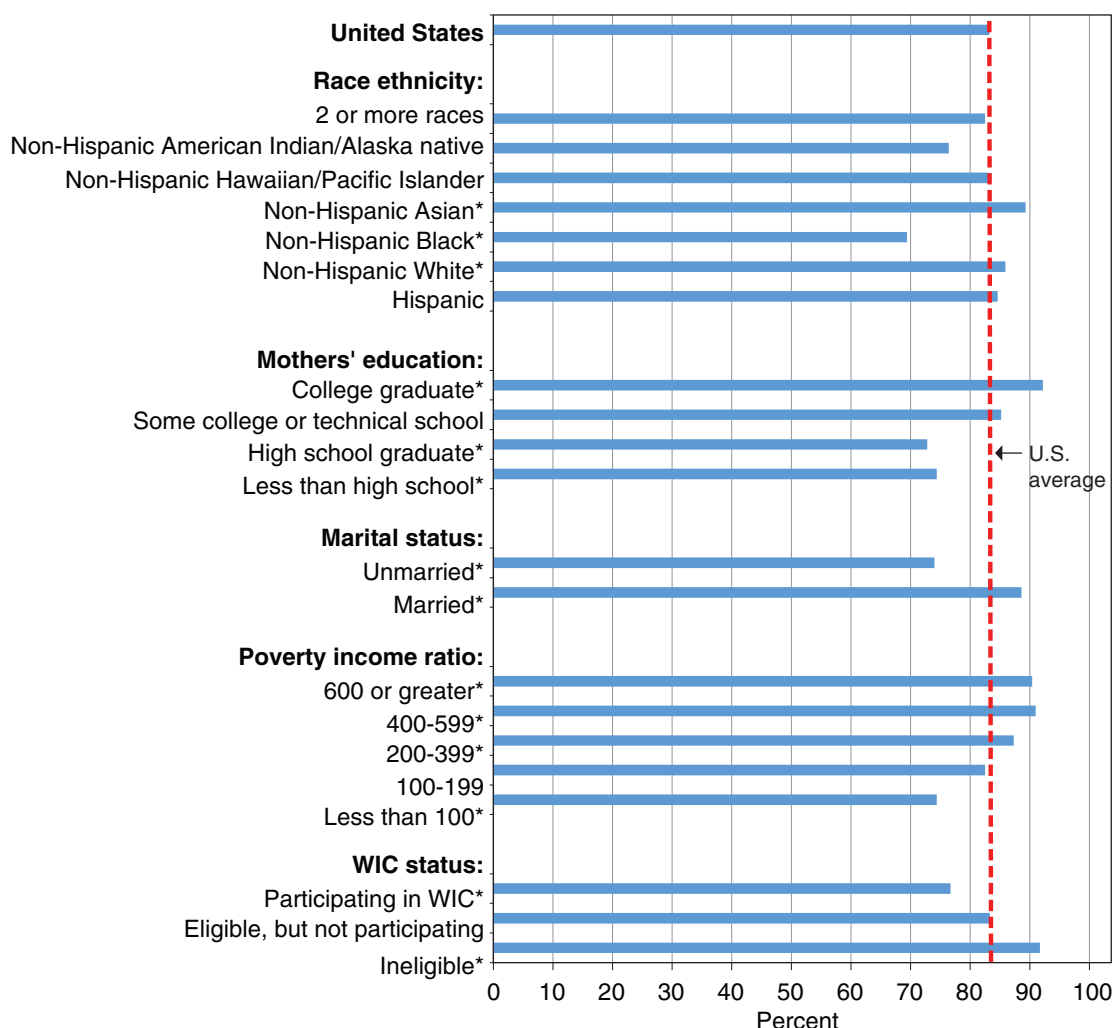
Figure 3
Exclusive breastfeeding rates, 2003-15



Source: USDA, Economic Research Service using National Immunization Survey (NIS), Centers for Disease Control and Prevention.

Figure 4

Rates of any breastfeeding by socio-demographic characteristics and WIC status among children born in 2015



Note: * = Statistically different from the U.S. average of 83.2 percent. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
 Source: USDA, Economic Research Service using National Immunization Survey (NIS), Centers for Disease Control and Prevention (2017).

WIC Breastfeeding Trends

Breastfeeding rates for WIC infants, similar to rates for all U.S. infants, have trended upward over time (see fig. 1). Although the gap between WIC and all infants has narrowed over time, any breastfeeding rates (ever, at 6 months, and at 12 months) and exclusive breastfeeding rates (through 3 months and through 6 months) for infants participating in WIC are below those of infants eligible but not participating (i.e., other low-income infants) and those who are ineligible to participate (i.e., higher income infants). For example, among children born in 2015, only 45 percent of those participating in WIC were estimated to be breastfeeding at 6 months, 21 percentage points below the rate for infants who were eligible for WIC but did not participate and 28 percentage points below the rate for infants not eligible to participate in WIC (table 1).⁷

⁷WIC eligibility was estimated based on household size and income.

Table 1

Rates of any and exclusive breastfeeding by WIC status among children born in 2015

	Any breastfeeding			Exclusive breastfeeding	
	Ever	At 6 months	At 12 months	Through 3 months	Through 6 months
WIC	76.7	44.5	25.4	38.0	17.8
Not in WIC, but eligible	83.3	65.8	47.2	51.2	29.7
Ineligible	91.7	72.6	47.4	57.8	33.1

Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service using U.S. Department of Health and Human Services, no date c.

Although breastfeeding promotion and support are central components of WIC, the program provides infant formula to help ensure that partially breastfed and nonbreastfed infants receive adequate nutrition.⁸ The provision of free infant formula has raised concerns that this acts as a disincentive for mothers to breastfeed (Tuttle, 2000; Ponza et al., 2004; Li et al., 2005; and Jacknowitz et al., 2007). However, women who plan on feeding formula to their baby may be more likely to enroll in WIC. Compared to women who are eligible for WIC but do not enroll, women who enroll in WIC are younger, less educated, lower income, less likely to be married, and more likely to be a smoker, characteristics associated with lower breastfeeding rates (Bitler and Currie, 2005; and Gundersen, 2005). Thus, the lower breastfeeding rates among women participating in WIC may reflect selection bias rather than an adverse effect of the program on breastfeeding (Jiang et al., 2010).

⁸The National WIC Association (2014) states that “In low income households, a lack of access to infant formula may increase the early introduction of cow’s milk or formula over-dilution with water. These practices may result in inadequate nutrition, iron-deficiency anemia, and/or water intoxication” (p.2). Jacknowitz et al. (2007) contend that because of the relatively high market price of infant formula, if WIC stopped offering infant formula, many nonbreastfeeding WIC mothers might choose to feed their infants less expensive but less nutritious alternatives, including cow’s milk.

Effects on WIC Program Costs and Participation

WIC is the Nation’s third largest food and nutrition assistance program, trailing only SNAP and the National School Lunch Program. In 2016, the reference period for this study, WIC served almost 7.7 million people per month, and Federal spending on the program totaled \$6.0 billion (USDA, 2017, b). Food packages accounted for almost two-thirds (66.1 percent) of total program costs in FY 2016, and costs for nutrition services and administration accounted for almost one-third (32.6 percent) (USDA, 2017, b).⁹

Increased breastfeeding rates in WIC would impact food package costs as well as costs for nutrition services and administration. To quantify these effects, we compared costs based on reported breastfeeding rates in 2016 to projected costs if breastfeeding rates in WIC hypothetically reached “medically recommended” levels, defined in this study as 90 percent of infants are exclusively breastfed for their first 6 months, followed by continued breastfeeding with the addition of complementary foods—but no infant formula—for the next 6 months. We chose “medically recommended” levels of breastfeeding as the standard against which to compare current breastfeeding behavior because they reflect goals identified by the health community. These goals are embodied in recommendations by AAP and other health organizations: exclusive breastfeeding for about 6 months followed by some breastfeeding for 1 year (or longer) as complementary foods are introduced.

The AAP recommendations do not explicitly address whether some women are unable to breastfeed. Bartick et al. (2017) and Stuebe et al. (2017) approximate breastfeeding recommendations by AAP and others by assuming that 10 percent of women are not able to breastfeed, meaning that in their studies, the share of infants who are breastfed (exclusively or with complementary foods) at “optimal levels” is 90 percent.¹⁰ We adopted the practice of Bartick et al., (2017) and Stuebe et al., (2017) for this study by assuming that 10 percent of mothers of infants receiving WIC benefits are unable to breastfeed.

This study’s definition of medically recommended breastfeeding levels explicitly specifies the duration for which a WIC infant receives no infant formula (i.e., 12 months). AAP’s policy statement on *Breastfeeding and the Use of Human Milk* clearly recommends against providing infants with formula during the first 6 months. However, the statement does not explicitly address the use of infant formula in months 7 to 12, instead recommending “continued breastfeeding as complementary foods are introduced” (American Academy of Pediatrics, 2012, p. e827). The policy statement concludes “that breastfeeding and the use of human milk confer unique nutritional and nonnutritional benefits to the infant and the mother and, in turn, optimize infant, child, and adult health as well as child growth and development” (p. e837). Presuming that breastfeeding is preferable to formula feeding not only in the first 6 months but also for months 7 to 12, this study operationalized “medically recommended” breastfeeding practices as excluding the use of infant formula during the infant’s entire first year. Thus, the term *medically recommended breastfeeding rates* as used

⁹In addition to food and nutrition services and administration costs, total WIC program costs include funds for program evaluation and monitoring, technical assistance, Farmers’ Market Nutrition Program, special projects, and infrastructure. These other costs accounted for about 1 percent of total program costs in FY 2016 (USDA, 2017, b).

¹⁰Stuebe et al. (2014) estimated that one in eight mothers who initiated breastfeeding reported early, undesired weaning attributed to physiologic difficulties with breastfeeding.

throughout this report means that 90 percent (rather than 100 percent) of infants are breastfed for 12 months, with no infant formula.¹¹

The hypothesized effects of increases in breastfeeding rates under alternative hypothesized scenarios are discussed in “Appendix G: Sensitivity Analysis.” Several of these alternative scenarios are based on less ambitious increases in breastfeeding rates than those under the medically recommended scenario. Another alternative scenario assumes that 90 percent of infants are exclusively breastfed for their first 6 months, followed by both breastfeeding and formula feeding (i.e., partial breastfeeding) for months 7 through 12. The sensitivity analysis addresses the uncertainty surrounding the achievability of reaching medically recommended levels of breastfeeding in WIC.

The following section provides a general overview of the effects that higher breastfeeding rates among mothers and infants receiving WIC benefits would have on both food package costs and administrative costs.¹² Estimating these effects required numerous steps, adjustments, and assumptions, which are discussed in greater detail in appendices as noted. All costs in this report are in 2016 dollars.

Effects on Food Package Costs

Specific food packages are prescribed for each category of WIC participants—infants, children, and pregnant, breastfeeding, and postpartum (i.e., nonbreastfeeding) women. The contents of the food packages provided to infants and mothers are based on the amount of infant formula the infant receives from WIC. *Fully breastfeeding* packages are for infants and mothers who do not receive formula through WIC. *Partially breastfeeding* packages are for infants and mothers who mostly breastfeed but who receive some formula through WIC. *Fully formula feeding* packages are for infants and mothers who are not breastfeeding or only breastfeed a minimal amount.¹³

Total food package costs were calculated as the product of the number of participants receiving each type of food package and the corresponding cost of that food package. Increased breastfeeding rates in WIC would affect total food package costs by: (1) increasing the number of mothers participating in the program per month, and (2) changing the distribution of participants across food package types.

Effects on number of participants. While breastfeeding mothers can participate in WIC for 12 months postpartum to supplement maternal diet during breastfeeding, Federal regulations (CFR 246.7) limit the participation of nonbreastfeeding mothers to 6 months postpartum. In FY 2016, a large number of women were fully formula feeding—i.e., not breastfeeding—their infants and therefore they did not participate in WIC after 6 months postpartum. If breastfeeding rates were to rise to medically recommended levels, fewer mothers would be fully formula feeding their infants and more would be breastfeeding their infants. Therefore, the number of mothers eligible to participate after 6 months postpartum would rise, resulting in an increase in the average

¹¹The term “medically recommended,” as used in this report, is consistent with AAP recommendations but may be interpreted as slightly stronger since AAP recommendations do not explicitly preclude the use of formula in months 7 through 12.

¹²For ease of discussion, “mothers” in this analysis includes both breastfeeding and nonbreastfeeding postpartum women.

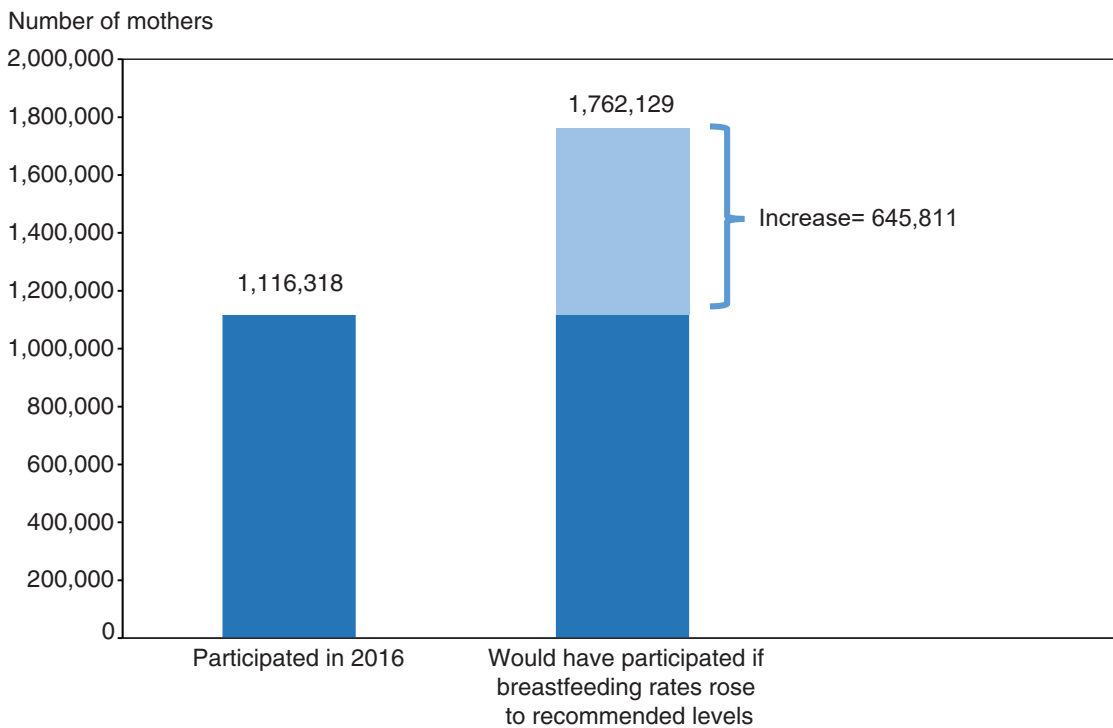
¹³Note that “fully breastfeeding” as used in WIC may differ from “exclusively breastfeeding” as used by CDC because an infant who receives WIC’s fully breastfeeding package may or may not also be fed solid foods and/or liquids other than formula.

number of mothers per month.¹⁴ As described in detail in Appendix A: Estimating the Number of WIC Participants If Breastfeeding Rates Increased to Recommended Levels, if breastfeeding rates increased to medically recommended levels, an estimated 645,811 additional mothers would participate in WIC each month (fig. 5). This represents a 57.9-percent increase in the average monthly number of mothers receiving WIC benefits and an 8.4-percent increase in the average monthly number of all WIC participants.¹⁵

Note that the increase in the monthly number of mothers participating in the program results from the same women staying in WIC longer—not from more women entering the program. That is, the number of unique postpartum women who participate in WIC is the same regardless of whether the mother participates for 6 or 12 months. However, because breastfeeding postpartum women can participate in WIC twice as long as nonbreastfeeding postpartum women, the average duration of participation will increase if breastfeeding rates in WIC increase, resulting in an increase in the average number of postpartum women participating in WIC per month.

Figure 5

Estimated change in average number of mothers in WIC (per month) if breastfeeding rates in WIC rose to recommended levels in 2016



Note: Recommended breastfeeding rates equal 90 percent fully breastfeeding and 10 percent fully formula feeding. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Source: USDA, Economic Research Service calculations based on data from USDA, no date, a.

¹⁴Since all infants in WIC can participate for their entire first year, the number of infants per month is unaffected if breastfeeding rates increase, although the distribution of infants across the three food package types would change.

¹⁵An average 7,696,439 women, infants, and children participated in WIC each month in FY 2016 (USDA, 2017, b).

Effects on distribution of participants across food package types. The amount of food in the various packages is set by regulation and does not vary with household income.¹⁶ The types and amounts of foods included in the packages for infants differ by the infants' breastfeeding status (fully breastfed, partially breastfed, or fully formula fed) and the infants' age (in months).^{17, 18} The types and amounts of foods included in the packages for mothers, as well as the length of time that mothers may receive the packages, differ by the mothers' breastfeeding status.

As a result of the differences in the types and amounts of food provided and, for mothers, the length of time allowed to receive a package, the monthly per participant food package costs (after rebates) vary by participant category.¹⁹ Table 2 shows estimated average monthly food package costs as redeemed (i.e., the cost for the portion of the package that was actually purchased by the WIC participant).^{20, 21} For infants, the fully breastfeeding food package is the least expensive in each of the 12 months (note that fully breastfed infants do not receive a food package for their first 6 months). The food packages for fully formula-fed infants are the most expensive.²² For mothers, the opposite is true. In recognition of their increased nutrient and caloric needs and to incentivize mothers to breastfeed, the fully breastfeeding packages are the most expensive of the packages for mothers for each of the 12 months, followed by the partial breastfeeding packages. The fully formula-feeding packages are the least expensive of the packages for mothers (note that fully formula-feeding mothers are not eligible to participate after 6 months postpartum).

As described in Appendix B: Estimating Food Package Costs Based on 2016 Breastfeeding Rates, we estimated the number of WIC infants and mothers in 2016 by food package type and, for infants, the age of the infant. The number of infants and mothers receiving each type of food package was then multiplied by the corresponding monthly food package costs from table 2. This product was in turn multiplied by 12 (the months in a year) to derive an annual estimate. Summing costs across the breastfeeding categories (fully breastfeeding, partially breastfeeding, and fully formula feeding) resulted in a total cost of the food packages for mothers of \$485.8 million and a total cost of the food packages for infants of \$1,025.2 million. Thus, based on 2016 breastfeeding rates, an estimated \$1,511.0 million was spent on mothers and infants food packages (table 3).

¹⁶WIC State agencies may tailor an individual's food package if medically or nutritionally warranted or if the participant refuses or cannot use the maximum monthly allowances.

¹⁷Information on the specific foods and amounts contained in the various WIC food packages is available on the FNS website.

¹⁸Age of infant in months is equivalent to mother's months postpartum.

¹⁹WIC has contractual agreements with infant formula manufacturers whereby WIC State agencies receive a specified rebate for every container of infant formula purchased by WIC participants.

²⁰In 2014, USDA asked the Institute of Medicine (IOM) to review and assess the program's food packages. As part of their analysis, IOM estimated the costs of the various food packages for FY 2015 based on unpublished price and redemption data from a convenience sample of six WIC State agencies (National Academies of Sciences, Engineering, and Medicine, 2017). We adjusted these estimates to 2016 dollars.

²¹Costs as redeemed are less than the maximum allowance prescribed to WIC participants because some participants redeem some, but not all, of their entire prescription.

²²The relatively higher cost of the food packages for fully formula-fed and partially breastfed infants is due in large part to the cost of infant formula, even after rebates.

Table 2

Monthly per-participant WIC food package costs after rebates as redeemed for infants and mothers, 2016

Infant			
Age of infant (months):	Fully breastfed ¹	Partially breastfed	Fully formula fed
0	--	\$6.56	\$54.36
1-3	--	\$26.77	\$54.36
4-5	--	\$32.20	\$59.85
6-11	\$34.66	\$37.36	\$57.05
Mother			
Months post-partum:	Fully breastfeeding	Partially breastfeeding	Fully formula feeding ²
0-5	\$48.01	\$37.14	\$30.14
6-11	\$48.01	\$37.14	--

Note: Mothers include both breastfeeding women and postpartum (i.e., nonbreastfeeding) women.

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

¹Fully breastfed infants do not receive food packages for their first 6 months.

²Fully formula-feeding mothers can only receive food packages up to 6 months postpartum.

Source: USDA. Economic Research Service calculations using National Academies of Sciences, Engineering, and Medicine (2017), table 7-3. All costs were adjusted to 2016 dollars using the Bureau of Labor Statistic's Consumer Price Index (CPI) for All Urban Consumers: All Items.

Table 3

Estimated WIC food package costs in 2016 by breastfeeding rates

	Estimates based on:		Difference
	2016 breastfeeding rates	Recommended breastfeeding rates	
	---Million dollars---		
Infant food package costs	\$1,025.2	\$478.5	-\$546.7
Mothers food package costs	\$485.8	\$998.7	\$512.9
Total	\$1,511.0	\$1,477.2	-\$33.8

Note: Recommended breastfeeding rates assume that 90 percent of infants/mothers are fully breastfeeding (no formula) for 12 months and 10 percent are fully formula feeding. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service.

As described in Appendix C: Estimating Food Package Costs Based on Recommended Breastfeeding Rates, a similar method was used to estimate total food package costs for WIC infants and mothers if breastfeeding rates in WIC increased to medically recommended levels (i.e., a fully breastfeeding rate of 90 percent for 12 months). As noted above, the estimated monthly number of mothers in WIC will increase if breastfeeding rates rise to medically recommended levels. We distributed the projected number of participating mothers and infants across the various food package types and, for infants, the infants' age.

The number of infants and mothers receiving each type of food package was then multiplied by the corresponding monthly food package costs from table 2. This product was in turn multiplied by 12 to derive the estimated annual total food package costs for infants and mothers. Summing across feeding categories and age of infant resulted in a total cost of the food packages for infants of \$478.5

million and \$998.7 million for the packages of breastfeeding and postpartum mothers, or a total \$1,477.2 million based on medically recommended breastfeeding rates (table 3).

Therefore, under the scenario whereby breastfeeding rates in WIC increased from 2016 levels to medically recommended levels, the estimated total food package costs for mothers would increase by \$512.9 million while the total food packages for infants would decrease by \$546.7 million (table 3). As a result, total food package costs would decrease by \$33.8 million.

Effects on WIC Nutrition Services and Administration Costs

Nutrition Services and Administration (NSA) costs consist of breastfeeding promotion and support costs as well as costs related to program management (overhead and management costs), client services (certification, issuance of food benefits, and referrals to other health care and social services), and nutrition education. Average monthly NSA costs vary by participant category. For example, monthly NSA costs averaged \$29.71 for pregnant and breastfeeding women, compared to only \$19.29 per month for postpartum women (fig. 6).²³

Increased breastfeeding rates in WIC would affect total NSA costs in two ways.²⁴ First, as discussed above, the average number of mothers participating in WIC each month would increase. Second, average per person NSA costs would increase since a greater percentage of the mothers participating in WIC would be breastfeeding.

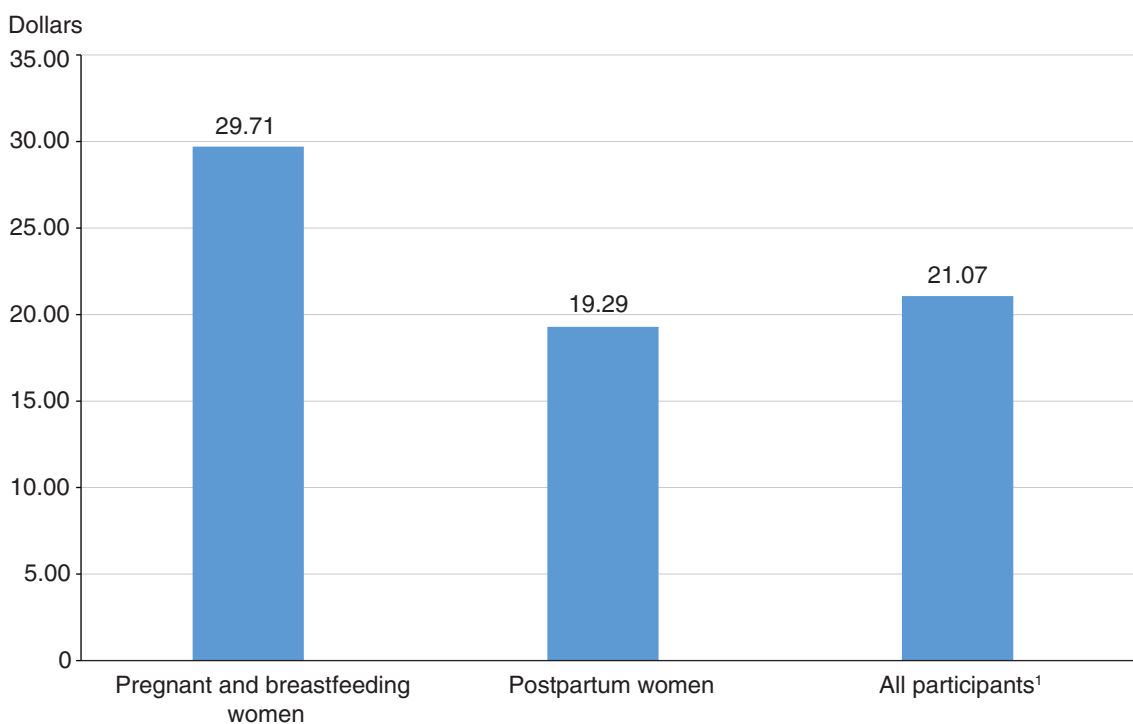
As shown in table 4, increasing the breastfeeding rate to medically recommended levels would increase the number of fully breastfeeding mothers participating in WIC by an estimated 1.4 million each month. Multiplying this increase in the monthly number of fully breastfeeding mothers by their average monthly NSA costs (\$29.71) and then by 12 (months in the year) results in an estimated increase in annual NSA costs of about \$512.7 million. This increase would be counterbalanced to some degree by the decrease in annual NSA costs attributed to the decrease in the number of partially breastfeeding mothers (345,000) and fully formula-feeding mothers (447,000). The estimated net effect of the increase in breastfeeding rates would be an increase to the WIC program of \$286.2 million in annual NSA costs.

²³WIC State agencies are required by law to spend a minimum amount—\$37.78 in FY 2016—adjusted annually for inflation, on each pregnant and breastfeeding (either fully or partially) woman in support of breastfeeding (USDA, 2016, a). In FY 2016, most WIC State agencies' actual expenditures spent on breastfeeding promotion and support far exceeded the legislatively mandated amount (USDA, 2018, a).

²⁴We assumed that increased breastfeeding rates would have no effect on the number of pregnant women in WIC. However, note that research suggests that breastfeeding suppresses ovulation and fertility after childbirth, and thus may delay subsequent pregnancies (Peterson et al., 2000).

Figure 6

Average monthly NSA costs by mothers' participant category, FY 2016



Note: NSA = Nutrition Services and Administration.

¹All participants includes infants and children in addition to pregnant, breastfeeding, and postpartum women.

Source: USDA, Economic Research Service calculations using data from USDA, 2018, a.

Table 4

Estimated change in FY 2016 NSA expenses by mothers' WIC participant category if breastfeeding rates increased to recommended levels

Mothers' participant category	Change in average number of participants	Average NSA expense per participant	Change in total monthly NSA costs	Change in total annual NSA costs
	<i>Per month</i>	<i>Per month</i>	<i>Per month</i>	<i>Annual</i>
Fully breastfeeding	1,437,982	\$29.71	\$42,722,445	\$512,669,343
Partially breastfeeding	-344,948	\$29.71	-\$10,248,405	-\$122,980,861
Fully formula feeding	-447,223	\$19.29	-\$8,626,932	-\$103,523,180
Total	645,811		\$23,847,108	\$286,165,302

Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. NSA = Nutrition Services and Administration.

Source: USDA, Economic Research Service.

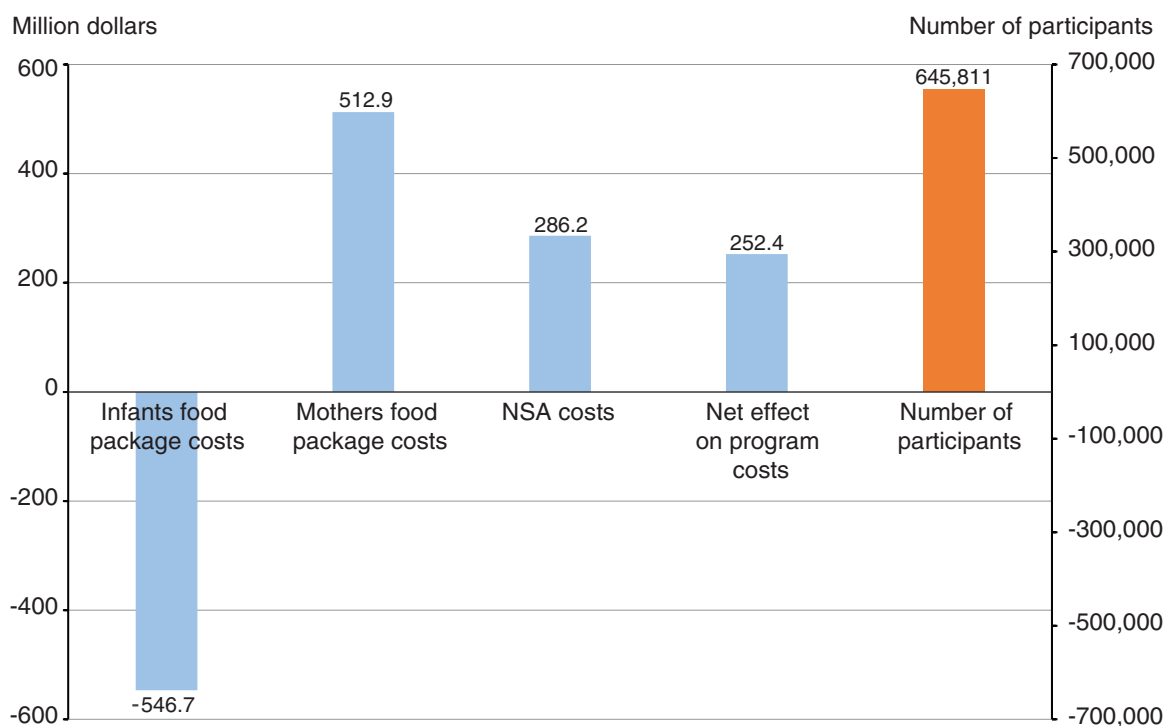
Net Effects on WIC

The net effects of increased breastfeeding rates on WIC program costs and participation are summarized in figure 7. Although costs of the mothers' food packages would increase by an estimated \$512.9 million, this would be more than offset by the estimated \$546.7 million decrease in costs to the infants' food packages. Costs for NSA activities would increase by \$286.2 million, resulting in a net increase in estimated WIC program costs of \$252.4 million. This net increase in costs would represent an increase of 4.2 percent in total WIC costs in FY 2016.²⁵ At the same time, total program participation would increase by almost 646,000 per month, or 8.4 percent.

It is important to note that these cost estimates are based on food package costs after deducting infant formula rebates, which totaled \$1.7 billion in FY 2016. The amount of infant formula rebates provided to WIC State agencies is determined by a bidding process among infant formula manufacturers and is therefore outside the direct control of WIC. The effect of increased breastfeeding rates on infant formula costs to WIC is highly uncertain; therefore, the study did not estimate these possible effects. (See Appendix D: Increased Breastfeeding Rates Could Impact Infant Formula Costs to WIC.)

Figure 7

Estimated effects of increased breastfeeding rates in WIC on program costs and number of participants, 2016



Note: Assumes breastfeeding rates increased to recommended levels. NSA = Nutrition Services and Administration. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. Source: USDA, Economic Research Service.

²⁵Federal expenditures for WIC totaled \$6.0 billion in FY 2016 (USDA, 2017, b).

Effects on Health-Related Costs

The economic impacts of increased breastfeeding rates in WIC extend beyond the cost to the program. Studies from a number of high-income countries have found that increases in breastfeeding initiation, duration, and exclusivity generate health benefits for infants and mothers. By reducing the incidence of various diseases or avoiding early death, increased breastfeeding among WIC participants reduces health-related costs to WIC households and/or their health insurance providers—both Government and private. In the United States, reviews of studies that estimated the health effects of breastfeeding have been conducted by DHHS’s Agency for Healthcare Research and Quality (AHRQ) (Ip et al., 2007) and the American Academy of Pediatrics (2012).²⁶ Drawing upon estimates from the AHRQ report and from peer-reviewed articles in the medical literature, Bartick et al. (2017) used the available evidence base to estimate costs associated with suboptimal breastfeeding rates. Developing a state-of-the-art simulation model, Bartick et al. (2017) estimated health benefits from reductions in the number of cases and deaths due to various diseases—and associated cost savings—that could potentially be gained if U.S. breastfeeding rates were to reach “optimal” levels.

The results of the Bartick et al. (2017) model were incorporated into a web-based, user-driven “Breastfeeding Savings Calculator” by the U.S. Breastfeeding Committee (USBC), an independent nonprofit organization consisting of a coalition of over 50 organizations along with (nonvoting) governmental members that include USDA’s Food and Nutrition Service (FNS) and a number of agencies in DHHS (Stuebe et al., 2017).^{27, 28} The USBC’s online calculator (based on evidence from peer-reviewed studies from high-income countries) produces estimates of costs associated with suboptimal breastfeeding or, in other words, estimates benefits from improved breastfeeding rates for the U.S. population as well as individual States with the baseline years of 2012 and 2014. Stuebe et al. (2017) detailed the methodology that underlies the web-based calculator. In particular, the USBC calculator defines “optimal” breastfeeding as exclusive breastfeeding for 90 percent of infants for 6 months and continued breastfeeding for 12 months.²⁹ The USBC’s online calculator did not produce estimates of health benefits for the subpopulation who participate in WIC. Our study modified the USBC calculator by adding data specific to the WIC population, including the number of WIC infants and breastfeeding rates for WIC mothers. Updating the year of study to 2016, we estimated health benefits and cost savings that could potentially be gained if breastfeeding rates of WIC mothers reach medically recommended levels.

²⁶The Dutch National Institute for Public Health and the Environment (Büchner et al., 2007) and the United Kingdom Committee for the United Nations International Children's Emergency Fund (UNICEF) (Renfrew et al., 2012) have also conducted reviews of breastfeeding studies conducted in high-income countries.

²⁷The calculator is available on the website of the U.S. Breastfeeding Committee.

²⁸Member organizations include: Academy of Nutrition and Dietetics, American Academy of Family Physicians, American Academy of Pediatrics, American Public Health Association, and the National WIC Association. The DHHS agencies include AHRQ, CDC, the Center for Food Safety & Applied Nutrition of the Food and Drug Administration, and the National Institute of Child Health and Human Development of the National Institutes of Health.

²⁹The USBC calculator does not differentiate on whether the continued breastfeeding is accompanied by infant formula. That is, the definition of “optimal” breastfeeding in the USBC calculator embodies the AAP recommendations, which urge exclusive breastfeeding for 6 months but do not explicitly preclude the use of formula in months 7 through 12. Note, however, that our earlier analysis of effects on the WIC program examined “medically recommended levels” of breastfeeding, which excluded the use of formula in months 7 through 12.

Health Outcomes and Categories of Cost Savings

The USBC calculator produces estimates of nine pediatric health outcomes and five maternal health outcomes (see Appendix E: Descriptions of the 14 Health Outcomes in the USBC Calculator).³⁰ For each selected disease, three outcomes were examined as possible results of a hypothetical increase in breastfeeding: (1) cases of the disease averted, (2) deaths averted (if applicable for the given disease), and (3) cost savings. Costs takes three forms:

- **Medical costs.** Medical expenditures are a cost whether they are paid directly by a household, an insurance company, or a Government program (such as Medicaid).
- **Nonmedical costs.** Some diseases that might have been avoided by breastfeeding result in lost wages from missed work while a mother recovers from a disease or while a parent takes care of an ill infant. The value of such time represents an opportunity cost due to lost economic productivity.
- **Cost of early death.** Some diseases increase the risk of death for a diseased person. Such deaths are early in the sense that under improved health, the risk of death would be lower, adding to longevity. Monetary values can be placed, at least roughly, on these changes in the risks to life.³¹

The extent to which a disease occurs in the population at risk varies across the diseases. Table 5 shows measures of disease incidence—the number of new cases per 100,000 infants or women—and the total number of new cases estimated for 2016. For example, gastrointestinal illness (GI) has a high incidence, averaging more than 2.2 episodes per infant (while the child is less than 1 year of age). In contrast, Crohn’s disease and ulcerative colitis are relatively rare among infants, with less than 1 new case per 100,000 infants. Among maternal diseases, incidence among the five diseases ranges from a low of 6.3 per 100,000 mothers for premenopausal ovarian cancer to a high of 1,621 cases of hypertension (per 100,000 women in appropriate age categories).

Table 5 also provides figures from Stuebe et al. (2017) of medical cost per case and nonmedical cost per case, by disease, calculated as the ratio of estimated costs saved (due to the increase in breastfeeding) relative to the estimated number of cases averted. Medical cost per case takes into account such factors as whether the cost data pertain to the first year in which the disease occurs or (for a chronic disease) a subsequent year or a year of death. Due to discounting, the cost of a disease that occurs in the future has a lower present value than the cost of the disease today. The method used to calculate cost per case used in Stuebe et al. (2017) takes these factors into account.

Among the pediatric diseases, medical cost per case is especially high for acute lymphoblastic leukemia (ALL), as are the nonmedical costs associated with the disease. As a result, even fairly small decreases in the risk of ALL due to increases in breastfeeding rates could have potentially large implications for saving medical and nonmedical costs. For maternal diseases, a similar point could be made for premenopausal ovarian cancer, diabetes, and myocardial infarction due to their relatively high medical costs.

³⁰We refer to all 14 health outcomes as “diseases,” even though outcomes such as hypertension, obesity, and sudden infant death syndrome (SIDS) can be considered to be “conditions.”

³¹Some studies include the costs of early death as a component of nonmedical costs. However, the USBC calculator reports death costs separately. We also report those costs separately because they are such a large component of cost savings.

Table 5

Incidence, medical costs, and nonmedical costs of pediatric and maternal diseases

Pediatric disease	Incidence ^a (per 100,000 births)	Number of new cases in 2016 ^b	Medical costs ^c (per case)	Nonmedical costs ^c (per case)
Acute lymphoblastic leukemia (ALL)	1.9 ^d	75	\$145,783	\$10,573
Crohn's disease	0.4 ^d	16	\$9,977	\$172
Ulcerative colitis	0.7 ^d	28	\$7,412	\$466
Ear infections (acute otitis media)	82,000 ^d	3,235,618	\$316	\$172
Gastrointestinal illness (GI)	220,000 episodes ^{d, e}	8,680,925 episodes	\$54	\$276
Lower respiratory tract infection (LRTI) (requiring hospitalization)	2,949 ^d	116,364	\$5,503	\$975
Obesity (among non-Hispanic White children)	9,100 ^d	179,946	\$2,959	\$238
Necrotizing enterocolitis (NEC)	168 ^f	6,629	\$24,475	\$484
Sudden infant death syndrome (SIDS)	42.5 ^g	1,677	Not applicable	Not applicable
Maternal disease	Incidence ^a (per 100,000 at-risk women)	Number of new cases among at-risk women	Medical costs ^c (per case)	Nonmedical costs ^c (per case)
<i>At-risk women are 35-70 years of age:</i>				
Breast cancer	329 ^h	241,178	\$23,932	\$5,481
Diabetes (type 2)	982 ⁱ	722,913	\$99,314	\$26,237
Hypertension	1,621 ⁱ	1,193,322	\$8,306	\$1,092
Myocardial infarction	226 ^j	166,373	\$95,207	\$4,363
<i>At-risk women are 15-51 years of age:</i>				
Premenopausal ovarian cancer	6.3 ^j	4,954 ^k	\$115,150	\$26,369

Notes and sources:

(a) Estimates of incidence are based on statistics from various sources.

(b) For most diseases, the estimated number of new pediatric cases in 2016 reflects the incidence reported in the table and the estimate of 3,945,875 infants born in 2016 (Martin et al., 2018); for obesity, an estimated number of non-Hispanic White children of 1,977,429 (Census Bureau, American Fact Finder, American Community Survey, no date).

(c) Medical and nonmedical costs per case are from appendix table A6 in Stuebe et al. (2017). All costs are 2016 dollars.

(d) Bartick et al., 2017, eTable9, appendix p. 16.

(e) Gastrointestinal illness is reported in terms of the number of annual episodes; a single infant may suffer from more than one episode.

(f) Incidence among all infants is based on an incidence of about 12 percent among infants weighing less than 1,500 grams (3 lb, 4 oz) (Gephart et al., 2012) and an estimated 2016 share of such infants, among all U.S. infants, of 1.4 percent (Martin et al., p. 47).

(g) Bartick et al., 2017, eTable13, appendix p. 19.

(h) Incidence of breast cancer is calculated using an estimated 236,968 new cases in 2014 (Centers for Disease Control and Prevention, no date, a) and the estimated number of women at-risk in 2014 of 72,118,352 (based on the 2010 share of U.S. females who are 35-70 years old and the number of U.S. females in 2014 of 161,783,394) (U.S. Census Bureau, American Fact Finder, no date).

(i) Incidence is calculated as weighted average of incidences specific to age groups reported in Bartick et al., 2017, eTable10, p. 17; weights equal women in age group as a share of all U.S. females age 35-70 in 2010 (Howden and Meyer, 2011, p. 4).

(j) Incidence is calculated as the weighted average of age-category incidences reported in Bartick et al., 2017, eTable 12, p. 18 and weights that equal the 2010 shares of the age categories relative to the total number of at-risk women 15-51 (Howden and Meyer, 2011, p. 4).

(k) In the Bartick et al. (2017) model, the at-risk group for premenopausal ovarian cancer is women 15-51 years old while for the other maternal diseases, the at-risk group is women 35-70 years old. For the table, the number of new cases of at-risk women reflects (1) the share of at-risk women among all U.S. females, calculated using numbers of U.S. females in various age categories from the decennial 2010 Census (Howden and Meyer, 2011, p. 4) and (2) the estimated number of U.S. females in 2016 of 164,048,590 (U.S. Census Bureau, American Fact Finder, no date). For 2016, the estimates of at-risk women 15-51 years old and 35-70 years old were 78,628,231 and 73,616,414.

In contrast, while gastrointestinal illness (GI) is a pediatric disease that is particularly common, the medical costs per case are the smallest of the pediatric diseases under study (the nonmedical costs per case are ranked fifth among the nine diseases). For an increase in breastfeeding rates to yield much savings in medical costs for GI, a relatively large change in the risk of GI illness would be required. Similarly, among maternal diseases, hypertension is relatively common but its medical and nonmedical costs per case are modest compared to other maternal diseases. Ultimately, the interplay among the various factors affecting cost savings from increased breastfeeding rates is an empirical issue—one that can be analyzed by the USBC calculator because it takes many factors into account simultaneously.

We applied the USBC calculator to estimate the costs savings that would accrue to WIC households (or their health insurance providers) if breastfeeding rates in WIC reached medically recommended levels (See Appendix F: Applying the U.S. Breastfeeding Committee Calculator to WIC Households). We define WIC households as households in which an infant participated in WIC regardless of whether or not the mother participated in the program. We use this definition of WIC households because, along with the participating infant, a mother who breastfeeds a WIC infant receives the health benefits of breastfeeding even if she is not a WIC participant herself.

Some, but not all, of the estimated cost savings for WIC households would appear in the pockets and budgets of the households. For example, all nonmedical costs as well as whatever portion of medical costs that WIC households pay out-of-pocket would translate into cost savings that would enhance WIC household budgets. However, some portion of the reduction in medical costs would accrue to private or government health insurers, to the degree that WIC participants are covered by health insurance plans. For example, for WIC participants who also participate in Medicaid, a portion of the reduction in medical costs would be saved by the Medicaid program, in which case taxpayers would receive the savings rather than WIC households. The cost savings associated with reductions in early death, which reflect improved life expectancy, have substantial value to the WIC household. However, the statistical value of improved life expectancy that was used by the USBC calculator is not equivalent to extra money that WIC households receive (see Appendix F: Applying the USBC Calculator to WIC Households).

Estimated Health-Related Cost Savings

The results of the analysis are shown in table 6.³² If mothers in WIC households were to increase breastfeeding rates from their 2016 levels to medically recommended levels, the estimated present value of savings would total about \$9.1 billion. Medical costs would account for \$1.5 billion of the estimated costs savings, and nonmedical costs would account for another \$0.6 billion. Reductions in early death accounted for \$6.9 billion—or over three-quarters of the total costs savings attributed to increased breastfeeding rates in WIC.

³²Our study provides point estimates of cost savings associated with increased breastfeeding rates. However, because our study lacked a state-of-the-art simulation model that could provide as many replications as Bartick et al. (2017), it does not estimate confidence intervals. To address uncertainty, Segal (2006) recommends sensitivity analysis that determines the range of possible values that costs can take by varying the model's assumptions. Following that recommended practice, our study conducted sensitivity analysis by varying the assumptions concerning breastfeeding behaviors—the core issue of the report (see Appendix G: Sensitivity Analysis).

Table 6

Estimated cost savings for WIC population if breastfeeding rates in WIC reached recommended levels in 2016

	Medical cost saved	Nonmedical cost saved	Early death cost saved	Total cost saved
	---Millions of 2016 dollars---			
Pediatric disease				
Acute lymphoblastic leukemia (ALL)	\$18.1	\$1.3	\$177.6	\$197.0
Crohn's disease	\$1.0	\$0.2	NA	\$1.0
Ulcerative colitis	\$0.6	\$0.4	NA	\$0.6
Ear infections (Acute otitis media)	\$97.9	\$53.5	NA	\$151.4
Gastrointestinal illness (GI)	\$69.1	\$352.7	NA	\$421.8
Lower respiratory tract infection (LRTI) (requiring hospitalization)	\$57.0	\$10.1	\$168.5	\$235.5
Necrotizing enterocolitis (NEC)	\$6.1	\$0.1	\$329.8	\$336.1
Obesity (among non-Hispanic White children)	\$59.6	\$4.8	NA	\$64.4
Sudden infant death syndrome (SIDS)	NA	NA	\$2,647.1	\$2,647.1
Subtotals for WIC infants	\$309.4	\$422.5	\$3,323.0	\$4,054.9
Maternal disease				
Breast cancer	\$58.1	\$13.3	\$1,306.5	\$1,377.9
Diabetes (type 2)	\$615.0	\$162.5	\$773.9	\$1,551.4
Hypertension	\$145.9	\$19.2	\$407.7	\$572.8
Myocardial infarction	\$398.1	\$18.2	\$1,168.1	\$1,584.5
Premenopausal ovarian cancer	-\$1.2	-\$0.3	-\$71.5	-\$73.0
Subtotals for mothers of WIC infants	\$1,216.0	\$212.9	\$3,584.7	\$5,013.6
Totals for WIC population	\$1,525.4	\$635.4	\$6,907.6	\$9,068.5

Note: NA = not applicable. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

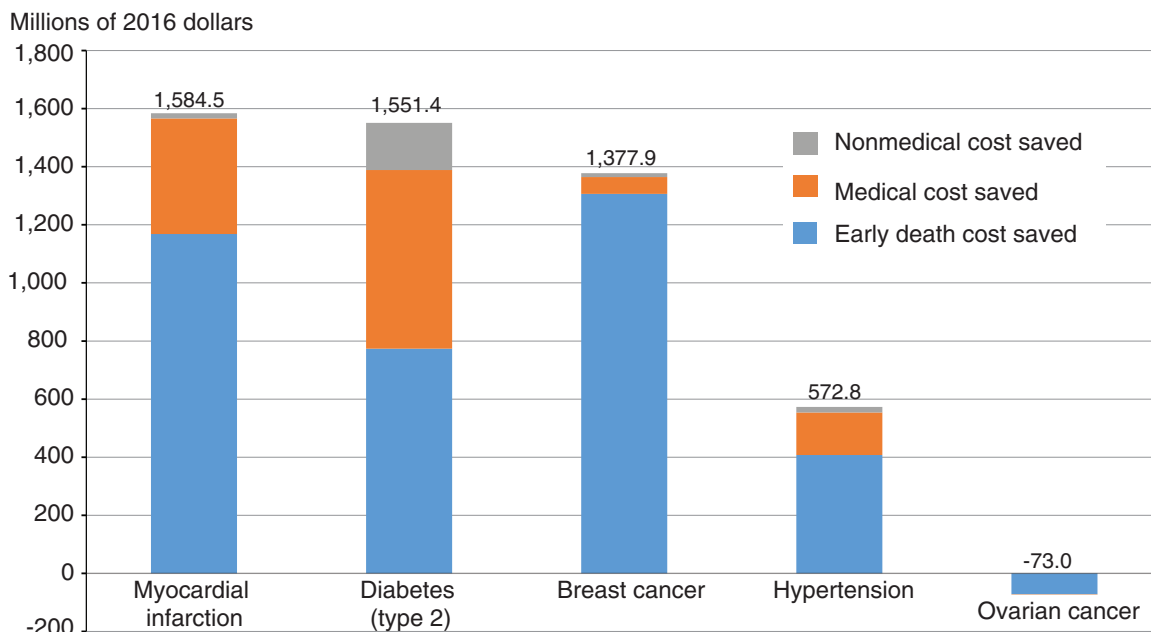
Source: USDA, Economic Research Service calculations using U.S. Breastfeeding Committee calculator.

Reductions in the five maternal diseases combined would account for \$5.0 billion in total cost savings, while reductions in the pediatric diseases account for \$4.1 billion. This result shows the importance of including the health benefits for mothers in addition to the health benefits for infants when estimating the economic benefits of breastfeeding on WIC households.

Reductions in the incidence of three maternal diseases—breast cancer, type 2 diabetes, and myocardial infarction—would each contribute from about \$1.4 billion to about \$1.6 billion in estimated total cost savings (fig. 8). For all three diseases, the cost of early death outweighs the medical costs (although medical costs for diabetes are almost 80 percent of death costs). Many of these saved maternal deaths would occur many (simulated) years after breastfeeding, which points to how—even with discounting—the costs of early death are substantial. Indirectly, these results show that changes in the probabilities of death from increased breastfeeding may seem small, but that even seemingly small changes can result in large cost savings because the value of saving even one statistical life is large. The negative dollar values associated with premenopausal ovarian cancer are attributable to the simulations, suggesting that this single disease may have a higher risk, rather than a lower risk, when breastfeeding rates increase. However, as reported in Bartick et al. (2017, p. 7), cost savings under optimal breastfeeding conditions were not statistically significantly different from zero for premenopausal ovarian cancer. Although the simulations were based on a study that found breastfeeding reduced the risk of the disease, the study’s estimates were not always statistically significant across various durations of breastfeeding.³³ Nevertheless, for consistency with the USBC, we report results for all diseases included in the calculator, whether statistically significant or not.

Figure 8

Estimated cost savings for WIC population if breastfeeding rates in WIC reached recommended levels, by maternal disease, 2016



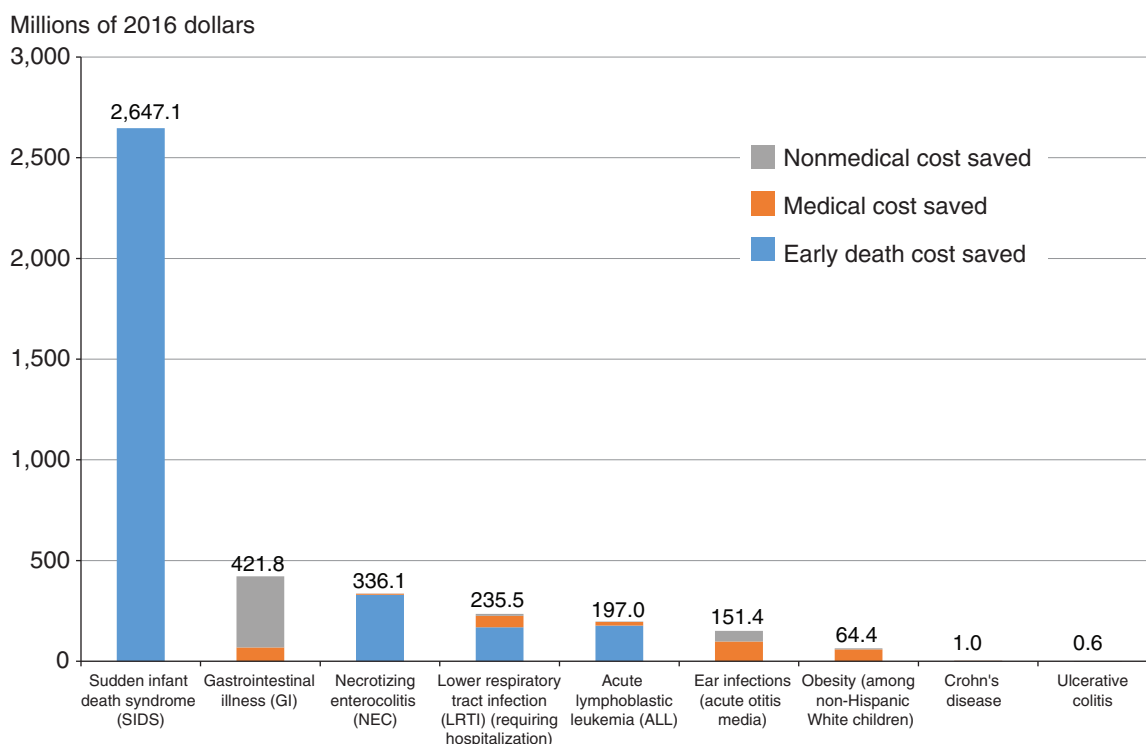
Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
 Source: USDA, Economic Research Service using U.S. Breastfeeding Committee calculator.

³³See Ip et al. (2007) for a review of several studies of the effect of breastfeeding on ovarian cancer.

Among the pediatric diseases, sudden infant death syndrome (SIDS) stands out because each case of SIDS necessarily involves an infant death. SIDS deaths prevented if breastfeeding rates increase to recommended levels would result in a total cost savings of \$2.6 billion (fig. 9). Gastrointestinal illness, at \$422 million, would have the second highest cost savings. This disease proves to be something of an exception in that its cost savings rest primarily on nonmedical costs saved—many parents take time off from work to care for infants with this common but not medically costly disease. Necrotizing Enterocolitis (NEC) would have cost savings of about \$336 million, which accrue primarily through early death costs saved.

Note that these estimates of cost savings are considered to be conservative. Assumptions that were built into the USBC calculator, which contributed to this report’s estimates, were deliberately made to avoid overstating breastfeeding’s impact on health and cost savings (Bartick et al., 2017).

Figure 9
Estimated cost savings for WIC population if breastfeeding rates in WIC reached recommended levels, by pediatric disease, 2016



Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
 Source: USDA, Economic Research Service using U.S. Breastfeeding Committee calculator.

Effects on Medicaid Costs

As discussed in the previous section, medical costs saved accounted for \$1.5 billion of the estimated total costs savings from increased breastfeeding rates in WIC (see table 6). These savings can accrue to individuals and their families (if uninsured) or to private and government health insurers via fewer health insurance claims. This section estimates the economic benefits that accrue to the public due to increased breastfeeding rates among WIC participants enrolled in the Medicaid Program.³⁴

Medicaid provides health care coverage to eligible low-income individuals. The program is the largest means-tested program in the United States (U.S. Congress, 2016). Over 68 million individuals—or about 1 in 5 Americans—were enrolled in the program as of October 2017 (U.S. Department of Health and Human Services, no date, f). Medicaid reimburses the providers of health care. By covering a range of medical services, Medicaid lowers participants' out-of-pocket costs. Medicaid is designed and administered by each State, subject to broad Federal guidelines. As a result, there is variation across States in terms of which groups are eligible and what services are covered.

Medicaid plays a major role in maintaining the health of WIC participants. Over two-thirds (71.0 percent) of all WIC participants were estimated to participate in Medicaid in 2016 (Thorn et al., 2018). This estimate, based on information compiled by State WIC agencies in a census of WIC participants, may underestimate participation of WIC participants in Medicaid.³⁵

To estimate the long-run cost savings to Medicaid resulting from increased breastfeeding rates among WIC participants, we assumed that 71 percent of WIC participants are enrolled in Medicaid up to the year of their death. That length of time is required in the simulations underlying the USBC calculator because some of the diseases included in the study have long time horizons—in particular, the maternal diseases such as breast cancer—that may not occur until many years have passed since the breastfeeding or formula feeding occurs.^{36, 37} We estimated savings in Medicaid costs resulting from higher breastfeeding rates in WIC by multiplying the total savings in medical costs attributed to higher breastfeeding rates in WIC (\$1.5 billion) by the estimated share of WIC participants who participate in Medicaid (0.71). Since Medicaid does not cover either nonmedical costs or costs related to early death, we restricted the analysis to medical costs and assumed that Medicaid covered all of an enrollee's medical costs. This resulted in an estimate of almost \$1.1 billion in medical costs saved due to the increased breastfeeding rates in WIC (table 7). This estimate represents the long-run Medicaid savings if breastfeeding WIC recipients in 2016 are enrolled in Medicaid in the future when the benefits accrue.

³⁴Data on the number of WIC participants who participate in other Government health insurance programs, such as the Children's Health Insurance Program (CHIP), Medicare, or Department of Veterans Affairs programs, were not available.

³⁵Thorn et al. (2018) states that "One potential reason for underreporting is that WIC staff may refer participants to other social service and/or health care programs; as a result, participant enrollment in other programs subsequent to WIC certification may not be captured in the estimates presented here. Another consideration is that constraints in various WIC management information systems, as well as required procedures for documenting income and participation in other programs, may have limited the number of other benefit programs WIC staff were able to enter into State agency management information systems for an applicant" (p. vi). They also find that 6.4 percent of participants had no data reported for one or more programs (p. 32).

³⁶Even if these current WIC participants no longer participate in Medicaid in the future, savings related to increased breastfeeding rates could accrue to the public if, in the future, the current WIC participant participates in some other Government health insurance program.

³⁷This estimate may be an overestimate (because some WIC participants currently on Medicaid do not remain on Medicaid in later years) or an underestimate (because some WIC participants who were not on Medicaid while enrolled in WIC join Medicaid in later years; and because the 71 percent figure is itself an underestimate).

Table 7

Estimated savings to Medicaid resulting from increased breastfeeding rates among the WIC population if breastfeeding rates reached recommended levels, by disease

	Long-run medical cost	Short-run medical cost (lower bound)
	---Thousands of 2016 dollars---	
Pediatric disease		
Acute lymphoblastic leukemia (ALL)	\$12,831	\$12,831
Crohn's disease	\$708	NA
Ulcerative colitis	\$406	NA
Ear infections (acute otitis media)	\$69,543	\$69,543
Gastrointestinal illness (GI)	\$49,057	\$49,057
Lower respiratory tract infection (LRTI)	\$40,448	\$40,448
Necrotizing enterocolitis (NEC)	\$4,357	\$4,357
Obesity (among non-Hispanic White children)	\$42,338	NA
Sudden infant death syndrome (SIDS)	\$0	NA
Subtotals for WIC/Medicaid infants	\$219,687	\$176,236
Maternal disease		
Breast cancer	\$41,237	NA
Diabetes (type 2)	\$436,678	NA
Hypertension	\$103,623	NA
Myocardial infarction	\$282,654	NA
Premenopausal ovarian cancer	-\$845	NA
Subtotals for mothers of WIC/Medicaid infants	\$863,348	NA
Totals for WIC/Medicaid population	\$1,083,035	\$176,236

Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children. NA = not applicable.

Source: USDA, Economic Research Service calculations using U.S. Breastfeeding Committee calculator.

However, because some WIC participants do not remain on Medicaid in the long run, we developed an alternative, short-run estimate that we use in the calculations that follow. In other words, we estimated the short-run savings to Medicaid due to increased breastfeeding rates in WIC that would accrue *while the participant was still likely to be enrolled in Medicaid*. To do so, we redid the analysis by restricting the diseases covered to those with a short time horizon as listed in the last column in table 7. We treat the estimate of short-run cost savings in Medicaid as a lower bound for two reasons: (1) the 71 percent figure is likely to be an underestimate of the proportion of WIC participants enrolled in Medicaid, as explained earlier, and (2) the diseases selected are only those that emerge over a short time horizon. The “true” (but unknown) Medicaid cost savings is likely to be between two “bookends”—the long-run estimate (which assumes that 71 percent of WIC participants remain enrolled in Medicaid in both the short run and the long run) and the short-run estimate (which assumes that 71 percent of WIC participants remain enrolled in Medicaid in the short run, but 0 percent remain enrolled in the long run).

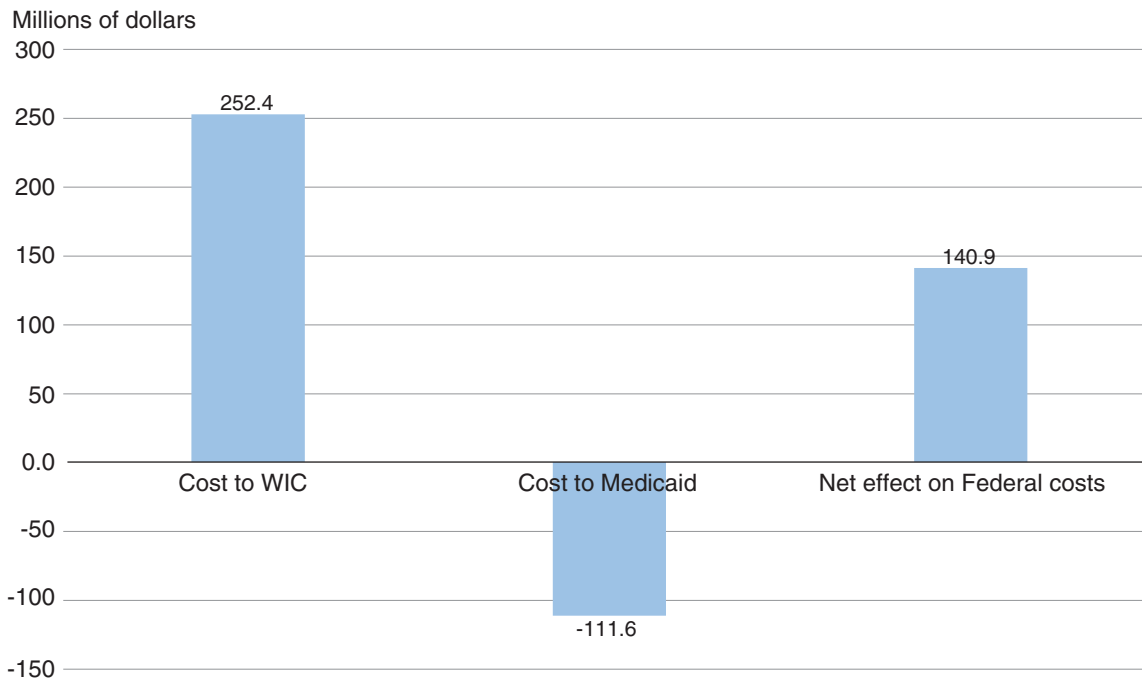
Results of the analysis indicate that if breastfeeding rates in WIC increased to medically recommended levels, estimated savings in medical costs to WIC participants enrolled in Medicaid would total at least \$176.2 million annually. Medicaid is funded jointly by States and the Federal Government, with the Federal Government providing an estimated 63.3 percent of the program’s funding in 2016 (U.S. Department of Health and Human Services, no date, d). As a result, the

Federal share of the savings in Medicaid resulting from higher breastfeeding rates in WIC was estimated to be \$111.6 million in 2016 (i.e., 63.3 percent of \$176.2 million), with the States saving an additional \$64.7 million.

Thus, the analysis indicates that the impacts of increased breastfeeding rates among WIC participants in 2016 on Federal program costs includes increased estimated costs to WIC of \$252.4 million (see chapter on “Effects on WIC Program Costs and Participation”) and reduced estimated costs to the Federal portion of Medicaid of \$111.6 million. The estimated net effect would be increased costs of \$140.9 million (\$252.4 million - \$111.6 million) in Federal expenditures (fig. 10).

Figure 10

Estimated effect on Federal costs if breastfeeding rates in WIC reached recommended levels, 2016



Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
Source: USDA, Economic Research Service.

Discussion and Conclusions

Breastfeeding rates in the United States have increased in recent decades but they remain below the levels recommended by the American Academy of Pediatrics and other U.S. health organizations, especially regarding duration and exclusivity. Breastfeeding rates among participants in WIC are lower than the national average. This study adds to the literature on economic impacts of breastfeeding by quantifying the effects that increased breastfeeding rates in WIC would have on the costs to WIC and Medicaid. Factors affecting WIC program costs are especially important since, as a discretionary program, WIC can only serve as many participants as its federally allocated budget allows. Although WIC has in effect been fully funded for the past several decades, there is no guarantee that Congress will continue to provide sufficient funding for WIC to serve all eligible applicants in the future.³⁸

This study found that if 2016 breastfeeding rates among WIC participants had hypothetically been at medically recommended levels, total WIC program costs would have risen by an estimated \$252.4 million, an increase of 4.2 percent of the program's total cost in 2016. A novel feature of our study is that its estimate of WIC costs takes into account the effect that increased breastfeeding rates would have on the number of mothers participating in the program per month. Results from the study indicate that if breastfeeding rates reached medically recommended levels, the number of mothers who participated in WIC in 2016 would have increased by an estimated 645,811 per month, an 8-percent increase in the total number of WIC participants. This increase in the monthly number of participants would have resulted from breastfeeding mothers being eligible to participate for 12 months after giving birth while nonbreastfeeding mothers are only eligible to participate for 6 months postpartum.

Although increased breastfeeding rates would increase estimated costs to WIC by \$252.4 million, Federal Medicaid costs would decrease by at least \$111.6 million as a result of the health benefits associated with breastfeeding. Thus, Federal costs to WIC and Medicaid combined would increase by an estimated \$140.9 million.

Another important contribution of the study is that it estimates the economic benefits of increased breastfeeding rates in WIC that accrue to WIC households themselves or to their health insurance providers, which would have totaled \$9.1 billion in 2016. Reductions in maternal diseases (including myocardial infarction, diabetes, and breast cancer) among women who breastfeed would have accounted for over half (56 percent) of total health-related cost savings. The remaining cost savings are due to reductions in pediatric diseases among breastfed infants.

The \$9.1 billion in total health-related cost savings takes three forms—reductions in medical costs, nonmedical costs, and the costs of early death. Over three quarters (\$6.9 billion) would have resulted from reductions in early deaths. The rest would be due to savings in medical costs (\$1.5 billion) and nonmedical costs (\$635 million). As discussed earlier, the savings in medical costs includes at least \$111.6 million in Federal Medicaid expenditures; the remaining savings would accrue to other government and private health insurers or to individual WIC participants.³⁹ Excluding the savings that accrue to the Federal portion of Medicaid (to avoid double-counting), the savings to WIC house-

³⁸The Center on Budget and Policy Priorities (2017) reports that since 1997, Congress has provided sufficient funding each year for WIC to serve all eligible applicants.

³⁹This study estimates that savings to State Medicaid programs would have totaled at least \$64.7 million.

holds or their health insurance providers would have totaled \$9.0 billion. Thus, although increased breastfeeding rates in WIC would result in higher overall costs to American taxpayers, WIC households (or their insurers) would realize large cost savings.

The estimates in this report represent annual values for 2016. They were derived from a comparison of actual 2016 (“base year”) conditions to estimated conditions that result from a hypothetical increase in medically recommended breastfeeding rates. However, if the hypothetical increase in breastfeeding rates were to be sustained over time, then additional economic effects would be generated in years that follow 2016. A rough estimate of *annual* economic effects resulting from a sustained increase in breastfeeding rates up to medically recommended levels are the study’s \$252.4 million of additional costs for the WIC program, \$111.6 million in Federal savings to Medicaid, and \$9.0 billion of additional health-related cost savings (excluding Federal Medicaid savings). However, extending those estimates to future years does not take into account possible changes from the base year 2016 conditions related to infant formula wholesale prices and rebates, the general price level, breastfeeding rates, or WIC participation.⁴⁰

The hypothesized increase in breastfeeding rates among WIC infants is based upon recommendations by the American Academy of Pediatrics and other U.S. health organizations (defined in this study as 90 percent of infants are exclusively breastfed for their first 6 months, followed by continued breastfeeding with the addition of complementary foods—but no infant formula—for the next 6 months). Achieving this ambitious goal would require substantial increases in the prevalence of breastfeeding, especially in regard to duration and exclusivity. As discussed in detail in Appendix G: Sensitivity Analysis, we also examined the economic impacts under various scenarios where breastfeeding rates increased more modestly. The results indicate that that increasing breastfeeding rates among WIC participants would increase WIC participation and both WIC and total Federal costs, while decreasing health-related costs to WIC households or their insurers. The magnitude of these effects varies depending on the degree to which the breastfeeding rates increase and the ratio of fully breastfeeding to partial breastfeeding participants.

The study has several limitations.

1. The health-related cost savings are conservative estimates. Consistent with Bartick et al. (2017), the underlying simulation model made conservative assumptions in order to avoid overestimating the impact on health of breastfeeding. In addition, the study implicitly treats the incidences of diseases among infants and mothers receiving WIC benefits, and the effects of breastfeeding on those incidences, as the same as those estimated among the general population. However, infants and mothers receiving WIC benefits are a disadvantaged population group that may be relatively more susceptible to some of the 14 diseases examined in the study.⁴¹ Therefore, increased breastfeeding could potentially improve health among the WIC population by more than among the general population, in which case our study underestimates its effect on cost savings.

⁴⁰For example, since peaking in fiscal year 2009, the number of WIC infants has fallen by about one-fifth. If this trend continues, economic effects in future years would be smaller than values estimated for 2016, holding other factors constant.

⁴¹Almost two-thirds (65.6 percent) of all WIC participants in 2014 reported incomes at or below the Federal poverty guideline, and about one-third (32.5 percent) reported incomes at or below 50 percent of the Federal poverty guideline (Thorn et al., 2018). Results from a survey conducted in 2011 indicated that one-quarter (27.1 percent) of women participants had less than high school education and only one-third had more than a high school education (Geller et al., 2012).

2. The effects of breastfeeding among the general population that are incorporated into the USBC calculator are drawn from a medical literature that is largely composed of observational studies in contrast to randomized controlled trials. While the Bartick et al. model and the resulting USBC calculator represent valuable contributions through their use of simulation methodology, the authors acknowledged the limitation that the model “assumed that observed associations between breastfeeding and disease are causal. It is possible that some of the observed associations are confounded by other factors” (Bartick et al., 2017, p. 10).
3. The economic benefits of breastfeeding considered in the study were not exhaustive. For example, increased breastfeeding decreases the environmental burden associated with the production, transportation, and disposal of infant formula cans and bottles (American Academy of Pediatrics, 2005). Other health and associated economic benefits may exist. For example, individual studies have shown an association between breastfeeding and increased cognitive development (Belfort et al., 2013; Deoni et al., 2013; and Mortensen et al., 2002), which in turn could lead to increased lifetime earnings.
4. The study did not estimate the repercussions of increased breastfeeding on several markets that would be directly affected. For example, if breastfeeding rates reached medically recommended levels, infant formula usage would decrease with potential negative implications for infant formula manufacturers.⁴² On the other hand, increased breastfeeding rates could be expected to increase the demand for breast pumps and lactation consultants (American Academy of Pediatrics, 2005). Other economic repercussions that spring from increased breastfeeding may be more subtle.⁴³
5. The report did not consider the additional financial investments that would be needed to achieve medically recommended breastfeeding levels. Breastfeeding promotion and support efforts—by entities such as WIC, other government agencies, health care providers, private insurers, employers, and other organizations—would likely have to be scaled up considerably to reach medically recommended breastfeeding levels in WIC.⁴⁴ The study did consider some costs to WIC of supporting more breastfeeding mothers (i.e., in the form of Nutrition Services and Administrative costs). However, that financial investment may be insufficient. Reaching medically recommended levels may require more expenditures in total and, importantly, per mother. These expenditures could be expected to increase nonlinearly with the breastfeeding rate. That is, as the breastfeeding rate approaches medically recommended levels, the investments needed to increase the rate further (by reaching, motivating, and supporting harder-to-reach mothers) are likely to rise. As a result, the financial investment needed to boost breastfeeding rates to, say, 10 percentage points above current levels would be less than the investment needed to boost rates by an additional 10 percentage points on top of that.

⁴²As discussed in Appendix D: Increased Breastfeeding Rates Could Impact Infant Formula Costs to WIC, increases in breastfeeding rates could affect the size of the infant formula rebates that manufacturers provide to WIC and, therefore, affect costs to WIC.

⁴³For example, breastfeeding requires “mothers to consume a small amount of additional calories” (U.S. Department of Health and Human Services, 2011, p. 4), thereby potentially affecting the food and farm sector.

⁴⁴Although this report focused solely on WIC and its participants, increasing breastfeeding rates to medically recommended levels for all U.S. infants would involve scaled-up investments similar to those for WIC infants.

The Surgeon General recommended that economic studies that estimate the complete cost-benefit ratio of breastfeeding be conducted to inform policy making (U.S. Department of Health and Human Services, 2011, p. 33). This study makes strides toward that objective by assessing the economic impact of an increase in breastfeeding rates among WIC participants on WIC, Federal Medicaid, and health-related costs. The study also illustrates how an increase in breastfeeding among WIC participants will result in an increase in the monthly number of mothers who participate in the program. Although increased participation in WIC increases program costs, it may increase social welfare by improving the health and well-being of low-income mothers and infants and decreasing their medical costs.

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Appendix A. Estimating the Number of Participants If Breastfeeding Rates Increased to Recommended Levels

FNS administrative data indicate that an average 1,875,706 infants per month participated in WIC in FY 2016, over two-thirds (68 percent) of whom were fully formula fed (appendix table A). We approximated medical recommendations by AAP by assuming that 90 percent of these infants (1,688,135) would be fully breastfed (i.e., no infant formula) for 12 months and that the remaining 10 percent of infants (187,571) would be fully formula fed. Under this approach, there would be no partially breastfed infants.

An average 1,116,318 mothers participated in WIC per month in FY 2016, of whom 523,934 (46.9 percent) were fully formula feeding and 592,384 (53.1 percent) were either fully or partially breastfeeding. To calculate the projected increase in mothers participating in WIC if breastfeeding rates increased to medically recommended levels, our methodology used administrative data on the number of participating infants and the ratios of the number of WIC mothers to the number of WIC infants by food package category in FY 2016.⁴⁵ This methodology takes into account eligible mothers who choose not to participate as well as participating mothers who exit the program before their eligibility ends.

FNS administrative data indicate that the ratio of fully breastfeeding WIC mothers (247,436) to fully breastfed WIC infants (247,835) on a monthly basis in 2016 was 99.8 percent. The ratio of fully formula-feeding mothers (523,934) to fully formula-fed infants (1,281,094) was 40.9 percent. In other words, mothers of fully breastfed WIC infants participated to a much greater extent on a monthly basis than mothers of fully formula-fed infants. The low ratio of fully formula-feeding mothers to fully formula-fed infants is due to: (1) fully formula-feeding mothers being able to participate for only half as long as fully breastfeeding mothers; and (2) a lower percentage of mothers of fully formula-fed infants participating in WIC even for 6 months.

Assuming that the same relationship between numbers of mothers and numbers of infants by food package type would occur if breastfeeding rates were to increase to medically recommended levels, we multiplied the projected number of fully breastfed infants (1,688,135) by .998. This results in an estimated 1,685,418 fully breastfeeding mothers who would participate in WIC if breastfeeding rates increased. Multiplying the projected number of fully formula-fed infants (187,571) by 0.409 results in an estimated 76,711 fully formula-feeding mothers participating in WIC. Thus, under the scenario whereby the breastfeeding rate in WIC rises to medically recommended levels, there would be an estimated 645,811 additional women (1,762,129 - 1,116,318) participating in WIC each month.⁴⁶

⁴⁵Increased breastfeeding rates in WIC are not expected to increase the number of infants in WIC, since they are eligible to participate for the full 12 months Infants, regardless of breastfeeding status.

⁴⁶This assumes that the program would continue to be fully funded.

Appendix table A

Average number of WIC participants per month in FY 2016 and estimated number if breastfeeding rates rose to recommended levels

	FY 2016		Estimate based on recommended breastfeeding rates		Difference
	<i>Number</i>	<i>Percent</i>	<i>Number</i>	<i>Percent</i>	<i>Number</i>
Infants:					
Fully breastfeeding	247,835	13.2	1,688,135	90.0	1,440,300
Partially breastfeeding	346,777	18.5	0	0.0	-346,777
Fully formula feeding	1,281,094	68.3	187,571	10.0	-1,093,523
Total	1,875,706	100.0	1,875,706	100.0	0
Mothers:					
Fully breastfeeding	247,436	22.2	1,685,418	95.6	1,437,982
Partially breastfeeding	344,948	30.9	0	0.0	-344,948
Fully formula feeding	523,934	46.9	76,711	4.4	-447,223
Total	1,116,318	100.0	1,762,129	100.0	645,811

Notes: Recommended breastfeeding levels equal 90 percent fully breastfeeding and 10 percent fully formula feeding.
WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service calculations based on data from USDA, no date, a.

Appendix B. Estimating Food Package Costs Based on 2016 Breastfeeding Rates

The methodology used to estimate the total food package costs of infants differed from that used to estimate the total food package costs of mothers.

Infants' food package costs. To estimate the total food package costs of infants, estimates of the number of participants by food package category are needed. Two factors complicate this estimation:

- Infants in WIC are certified up to their first birthday, and the type of food packages the infants receive from WIC depends on their breastfeeding status, which may change during this period. That is, infants do not have to stick with the same food package type throughout the infant's first year. For example, an infant can change from the fully breastfed to the fully formula-fed package. Women can request changes to the type of food package they and their infant receive when they deem it necessary, in some sites as often as once per month if that month's vouchers have not already been redeemed (May et al., 2017).
- For a given "type" of food package (fully breastfed, partially breastfed, and fully formula fed), the cost of the food package varies by age of infant (due to changes in the types and amounts of foods).

There is asymmetrical movement within the infant food package categories over the 12 months (Drago, 2011, p. 282). Because mothers who stop breastfeeding a child are unlikely to breastfeed that child again, it is improbable that infants who are fully formula fed would ever move back into either the fully or partial breastfeeding groups. As a result, the proportion of infants (and mothers) who receive the fully breastfed package will only decrease or remain constant (i.e., not increase) as the infant ages.

Data on the number of infants by type of food package received and infant's age are not available. Therefore, we estimated the number of participants receiving specific food packages by age of infant, which required several steps. May et al., (2017, p. 5-7) provided estimates of WIC mothers' *infant feeding choice*—only breastmilk, both breastmilk and formula, and only formula—at 1, 3, 5, 7, 9, and 11 months postpartum for 2013 (appendix table B-1).^{47, 48} We used mothers' infant feeding choice to proxy for the *type of food package* (fully breastfed, partially breastfed, and fully formula

⁴⁷May et al. (2017) also provide estimates of WIC mother's infant feeding choice at 13 months—outside our 12-month study period.

⁴⁸A small percentage of mothers (1.2 percent in month 7, 2.1 percent in month 9, and 5.1 percent in month 11) reported their feeding decision as neither breastmilk nor formula during a dietary recall (May et al., 2017). For this analysis, we assumed that these respondents were fully formula feeding.

fed) issued to infants.⁴⁹ Using an exponential model, which is often used with duration data, we estimated regressions based on the six reported monthly prevalences for fully breastfeeding food packages; prevalences for partial breastfeeding packages were modeled separately.⁵⁰ The regressions captured the declining prevalences of fully and partial breastfeeding as infants age (appendix figure B). From the resulting equations, 12 monthly percentages were estimated by type of food package issued (i.e., from .5 month to 11.5 months). We used the midpoint of each month (e.g., 0.5, 1.5, 2.5) to represent the food package selection of infants in that month.

Appendix table B-1

Percentage of WIC mothers by breastfeeding status and age of infant, 2013

Age of infant (in months)	Exclusive breastfeeding ¹	Combination feeding ²	Exclusive formula feeding ³
1	30.3	30.7	39.0
3	19.8	21.9	58.3
5	15.9	15.7	68.4
7	14.5	11.6	73.9
9	13.7	8.4	77.9
11	13.0	6.8	80.2

Note: Data were based on a sample of women and their infants enrolled in WIC either prenatally or before infant was 2.5 months old during the summer or fall of 2013 who were then followed longitudinally. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

¹Infants may be eating other complementary foods but not formula.

²Breastfeeding in combination with formula feeding.

³Infants may be eating other complementary foods but not breastmilk.

Source: USDA, Economic Research Service using May et al., 2017.

To obtain consistency with national figures from FNS administrative data, we adjusted each estimated series.⁵¹ For example, according to FNS administrative data, 13.21 percent of all WIC infants received the fully breastfed package in fiscal 2016. However, the estimate based on the 2013 survey-based data indicated that 17.63 percent of WIC mothers exclusively breastfed their infant in 2013.

⁴⁹Mothers' feeding choice is not fully synonymous with infants' food package type. However, comparisons of the estimated distribution of mothers' infant feeding choices to the distribution of infant food package types based on FY 2016 administrative data indicate a generally high level of agreement. Our estimated distribution of infants by mothers' feeding choice—only breastmilk, both breastmilk and formula, and only formula-fed—was 17.6 percent, 15.8 percent, and 66.5 percent, which differs slightly from the distribution of food package types based on FY 2016 FNS administrative data (13.2 percent, 18.5 percent, 68.3 percent). Reasons for the differences between mothers' feeding choice and infants' food package type include differences in study year (our estimates of mothers' feeding choice are based on responses from a sample of participants in 2013 while the FNS-based distribution is for FY 2016), definitional differences, and possible misreporting. In addition, the feeding choice of some women may not necessarily match the type of food package received through WIC. For example, infants receiving WIC's fully breastfeeding food package "may or may not be exclusively breastfeeding. Fully breastfeeding means only that the infant is not receiving formula from WIC. While the assumption that forms the basis for the fully breastfeeding food package is that breastfeeding women who elect not to receive formula from WIC are exclusively breastfeeding, there may be instances where mothers supplement with formula from non-WIC sources. Although not breastfeeding exclusively, these mothers are nonetheless designated fully breastfeeding by WIC regulations" (USDA, 2016, b).

⁵⁰The estimated equation for fully breastfeeding was $27.163 * \exp(-.078 * \text{infant's age in months})$ which had a R^2 of .833. The estimated equation for partial breastfeeding was $34.644 * \exp(-.153 * \text{mother's months postpartum})$ which had a R^2 of .996.

⁵¹For simplicity, we ignored the higher-cost food packages prescribed to infants with certain medical conditions. Patlan and Mendelson (2016, page C-2) estimated that in 2014, 9.4 percent of WIC infants had certain documented medical conditions and received a medical food package that had a different cost structure than the nonmedical food packages for infants. Few women were reported as receiving medical food packages.

As discussed in footnote 48, it is not expected that there would be exact agreement between the two figures. Nevertheless, to reconcile the discrepancy, the study adjusted the 12 estimated prevalences so that, post-adjustment, their monthly average would equal the national prevalence. To do this, we subtracted -4.42 (i.e., 13.21-17.63) percentage points from the estimates for fully breastfed infants. A similar approach was used to adjust the estimates for partially breastfed infants (by adding percentage points). The estimated percentage of infants issued the fully formula-fed package was derived by subtracting the sum of the adjusted estimated percentages of fully and partially breastfed infants and mothers from 100 percent.

In order to derive the numbers of food package types, by age of infant, from the three series of prevalences of food package types (fully breastfed, partially breastfed, fully formula fed), we assumed steady-state conditions. That is, the number of infants entering WIC at birth is constant throughout the year and that appendix figure B describes patterns of prevalences for all WIC infants as they are born and age through their first year. We estimated the numbers of food packages for fully breastfed infants for each age of infant (first month, second month, etc.) as some fraction of the monthly average number of fully breastfed food packages issued in 2016 (which is known to be 247,835 from FNS administrative data). Under the assumption of steady-state, the fraction for each age, f_i , is given by:

$$(A.1) f_i = \left(\frac{\tilde{p}_i}{\sum_i \tilde{p}_i} \right), i = 0.5, 1.5, \dots, 11.5 \text{ months}$$

where \tilde{p}_i is the adjusted prevalence for an infant at age i . The same approach was used to obtain a set of 12 fractions for partially breastfed infants (and fully formula fed), by age, and to allocate the number of partially breastfed (fully formula-fed) food packages of 346,777 (1,281,094) (see appendix table B-2).

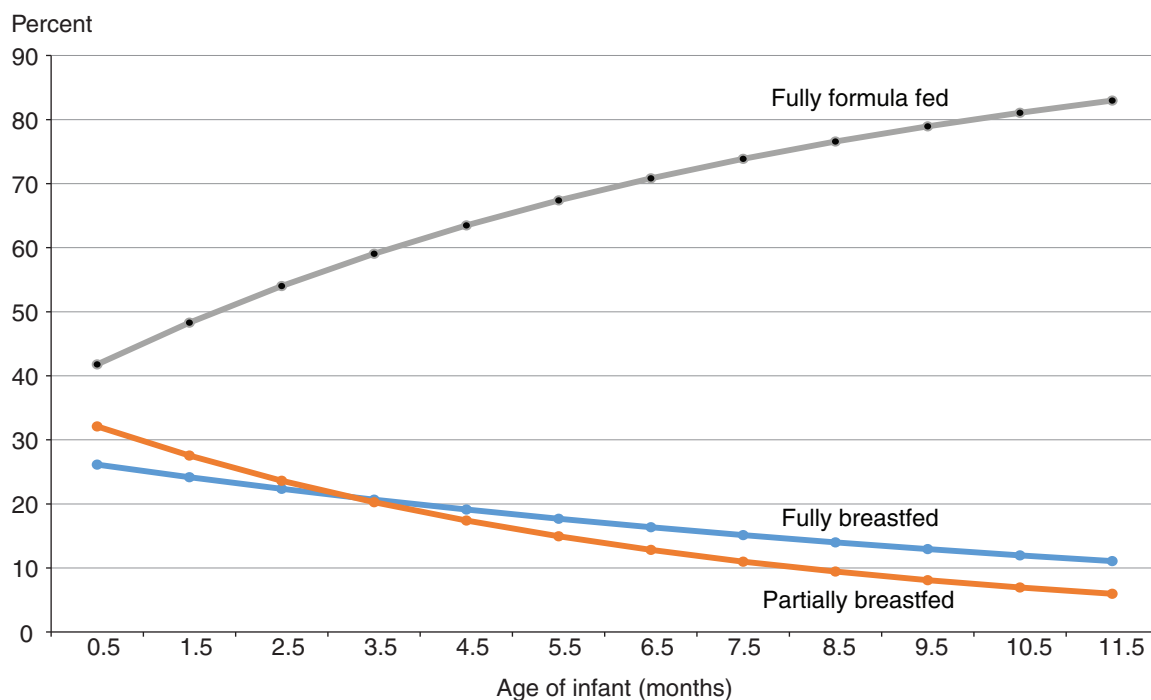
We then multiplied the number of infants in each month and food package type by the corresponding per-participant cost of the food package (appendix table B-3), and then multiplied each product by 12 (i.e., the number of months in a year). Summing across feeding categories and age of infant resulted in a total cost of the food packages for infants of \$1,025.2 million.

Mothers' food package costs. The monthly food package costs for mothers vary by type of package, but, unlike the costs of the infants' food packages do not vary by infants' ages (or mothers' months postpartum) (see appendix table B-3). That is, the monthly costs of food packages for all fully breastfeeding women (\$48.01) and for all partially breastfeeding women (\$37.14) are the same for each of the 12 months the mothers participate in WIC. The monthly costs of the food packages were also the same for all fully formula-feeding women in WIC (\$30.14), although they can only participate for up to 6 months postpartum.

As a result, estimating the total costs of the food package for mothers was relatively straightforward. We multiplied the average monthly number of mothers participating in WIC in FY 2016 based on food package type by the cost of that food package (appendix table B-4). Summing across the three food package types and the multiplying the product by 12 (i.e., months in a year) resulted in a total cost of the food packages for mothers of \$485.8 million.

Appendix figure B

Estimated percentage of infants receiving WIC benefits by food package type and age of infant, 2013



Note: May et al., 2017 was based on a sample of WIC mothers recruited as they enrolled in WIC (either prenatally or before the infant was 2.5 months old) during the summer or fall of 2013. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service calculations based on data from May et al., 2017.

Appendix table B-2

Estimated monthly number of WIC infants by infant's age and food package type, FY 2016

Age (months)	Number of infant participants			
	Fully breastfed	Partially breastfed	Fully formula fed	Total
0.5	33,923	54,294	68,091	156,309
1.5	30,859	47,178	78,272	156,309
2.5	28,025	41,071	87,213	156,309
3.5	25,404	35,830	95,075	156,309
4.5	22,979	31,333	101,997	156,309
5.5	20,736	27,474	108,099	156,309
6.5	18,662	24,162	113,485	156,309
7.5	16,743	21,320	118,246	156,309
8.5	14,968	18,882	122,459	156,309
9.5	13,326	16,789	126,194	156,309
10.5	11,808	14,993	129,508	156,309
11.5	10,403	13,452	132,454	156,309
Total	247,835	346,777	1,281,094	1,875,706

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service.

Appendix table B-3

Monthly per-participant WIC food package costs after rebates as redeemed for infants, 2016

Age of infant (months):	Fully breastfed ¹	Partially breastfed	Fully formula fed
0	--	\$6.56	\$54.36
1	--	\$26.77	\$54.36
2	--	\$26.77	\$54.36
3	--	\$26.77	\$54.36
4	--	\$32.20	\$59.85
5	--	\$32.20	\$59.85
6	\$34.66	\$37.36	\$57.05
7	\$34.66	\$37.36	\$57.05
8	\$34.66	\$37.36	\$57.05
9	\$34.66	\$37.36	\$57.05
10	\$34.66	\$37.36	\$57.05
11	\$34.66	\$37.36	\$57.05

¹Fully breastfed infants do not receive food packages for their first 6 months.

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service using National Academies of Sciences, Engineering, and Medicine (2017), table 7-3. All costs were adjusted to 2016 dollars using the Bureau of Labor Statistic's Consumer Price Index (CPI) for All Urban Consumers: All Items.

Appendix table B-4

Estimated monthly cost of the mothers' food packages, by food package type, FY 2016

	Fully breast-feeding	Partially breast-feeding	Exclusive formula feeding	Total
Average number of participants per month	247,436	344,948	523,934	1,116,318
Monthly cost of the food package (per month while participating in the program)	\$48.01	\$37.14	\$30.14	
Total costs of the food package per month	\$11,878,935	\$12,812,306	\$15,788,983	\$40,480,225
Annual cost of the food package	\$142,547,220	\$153,747,676	\$189,467,802	\$485,762,698

Source: USDA, Economic Research Service.

Appendix C. Estimating Food Package Costs Based on Recommended Breastfeeding Levels

On average, 1,875,706 infants participated in WIC per month in FY 2016. We approximated medical recommendations by AAP by assuming that 90 percent of these infants (1,688,135) would be fully breastfed (i.e., no infant formula) for 12 months and that the remaining 10 percent of infants (187,571) would be fully formula fed. We then multiplied the number of infants in each month (appendix table C) and food package type by the corresponding per-participant monthly cost of the food package as reported in table 3, and then multiplied the products by 12 (the number of months in a year). Summing across feeding categories and age of infant resulted in a total cost of the food packages for infants of \$478.5 million.

To estimate what the cost of the food packages for mothers would be if breastfeeding rates reached medically recommended levels, we took into account the increase in the number of participating mothers as discussed in appendix A. Thus, the average number of fully breastfeeding mothers totaled 1,685,418 for each of the 12 months postpartum. Reflecting that fully formula-feeding mothers can only participate for the first 6 months postpartum, the average number of fully formula-feeding mothers per month was 76,711. We then multiplied the number of mothers in each month and food package type by the corresponding monthly per-participant cost of the food package as reported in table 2, and then multiplied each product by 12 (i.e., the number of months in a year).

Summing across feeding categories and months postpartum resulted in a total cost of the food packages for mothers of \$998.7 million. Adding the total costs of the food packages for infants to that of mothers if breastfeeding levels reached medically recommended levels resulted in an estimated total cost of the food packages of \$1,477.2 million.

Appendix table C

Estimated monthly number of WIC infants by age and food package type in FY 2016, assuming recommended breastfeeding levels

Age (in months)	Fully breastfed	Partially breastfed	Fully formula fed	Total
0.5	140,678		15,631	156,309
1.5	140,678		15,631	156,309
2.5	140,678		15,631	156,309
3.5	140,678		15,631	156,309
4.5	140,678		15,631	156,309
5.5	140,678		15,631	156,309
6.5	140,678		15,631	156,309
7.5	140,678		15,631	156,309
8.5	140,678		15,631	156,309
9.5	140,678		15,631	156,309
10.5	140,678		15,631	156,309
11.5	140,678		15,631	156,309
Total	1,688,135		187,571	1,875,706

Notes: Recommended breastfeeding levels are equivalent to 90 percent fully breastfed and 10 percent fully formula fed. WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

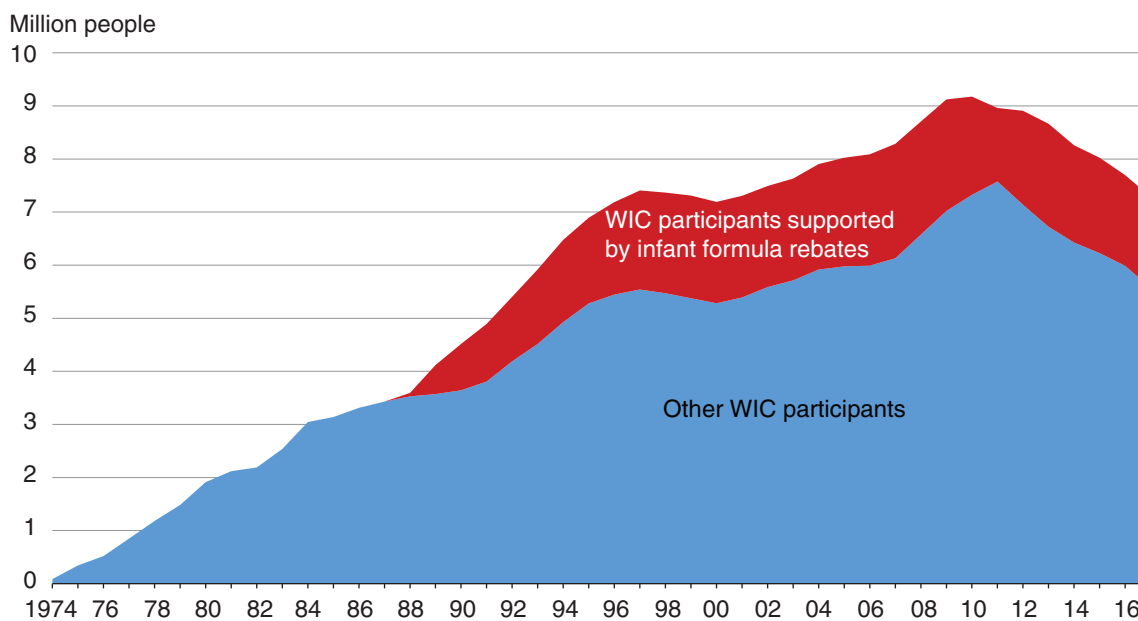
Source: USDA, Economic Research Service.

Appendix D. Increased Breastfeeding Rates Could Impact Infant Formula Costs to WIC

Infant formula is the single most expensive food item for WIC, accounting for 42 percent of total food costs in FY 2010 before rebates (Vericker et al., 2013). To reduce costs, Federal law requires that WIC State agencies enter into cost-containment contracts for the purchase of the infant formula used in WIC. Typically, WIC State agencies obtain discounts in the form of rebates from infant formula manufacturers for each container of formula purchased through the program. In exchange for the rebates, the State agency agrees to issue the manufacturer's infant formulas as the formula of first choice to its infant participants.⁵² The use of rebates has been very effective at reducing costs. After rebates, infant formula accounted for only 20 percent of total WIC food costs in FY 2010 (Vericker et al., 2013). Infant formula rebates totaled almost \$1.7 billion and supported about 24 percent of all participants in FY 2017 (USDA, no date, b) (appendix fig. D).⁵³

Appendix figure D

Average monthly number of WIC participants supported by rebates, FY 1974-2017



WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Note: The number of WIC participants supported by infant formula rebates was calculated by multiplying the total number of WIC participants by rebates' share of total program expenditures and rebates.

Source: USDA, Economic Research Service calculations based on USDA, Food and Nutrition Service estimates of number of participants and USDA, Food and Nutrition Service estimates of infant formula rebates.

⁵²As a result, the brand of formula provided by WIC varies by State, depending on which company holds the rebate contract.

⁵³Basically, the number of WIC participants supported by infant formula rebates can be thought of as the number of WIC program participants who would not be able to participate (due to lack of funds) if there were no rebates (holding program funding constant).

Increased breastfeeding rates could potentially impact total WIC program costs by affecting the per-unit cost of the infant formula provided through the program. This study's analysis assumes that per-unit costs of infant formula to WIC would be unaffected by a hypothetical increase in breastfeeding rates. Although a number of factors could theoretically affect the per-unit cost of infant formula to WIC, developing numerical estimates of such effects is hindered by the lack of available data. This appendix draws on economic principles to consider possible effects that increases in breastfeeding rates might have on the per-unit cost of infant formula to WIC.

WIC Infant Formula Cost Components

Single supplier infant formula contracts are awarded to the manufacturer offering the WIC State agency the lowest net price, as determined by the manufacturer's wholesale price minus the rebate:

$$\text{Net price} = \text{Wholesale price} - \text{Rebate}$$

An earlier ERS study found that among contracts in effect as of February 2013, the average percentage discount—that is, the amount of the rebate as a percentage of the wholesale price—was 92 percent (Oliveira et al., 2013). In other words, WIC was paying only 8 percent of the wholesale price for formula. Anecdotal evidence suggests that WIC is currently paying an even lower percentage of the wholesale price. Manufacturers likely provide such large percentage rebates for two main reasons. First, because WIC accounts for over half of all infant formula sales in the United States, winning the WIC infant formula contract ensures large sales for the contract-winning manufacturer (Oliveira et al., 2010). Second, there is evidence that a manufacturer that wins the WIC contract in a State realizes indirect (or spillover) effects in the non-WIC market (Oliveira et al., 2011). For example, because WIC infants account for a large portion of all infant formula consumers, retailers may devote more shelf space and better product placement to the WIC contract brand, which in turn may spur sales of the contract brand to non-WIC consumers. Spillover effects are important to the formula manufacturers since, unlike formula purchased through WIC, manufacturers do not pay a rebate on formula that is purchased outside the program.⁵⁴

Net price is only one component of what WIC pays for infant formula. Participants in all States except Vermont and Mississippi purchase infant formula from authorized retail vendors using a food instrument (i.e., voucher, check, or electronic benefits transfer (EBT) card) that specifies the brand and amount of formula that can be purchased. WIC State agencies reimburse the vendor for the full retail price of the formula purchased with WIC food instruments (WIC State agencies then receive the rebates from the manufacturer holding the WIC contract). As a result, the actual cost to WIC for each container of infant formula sold through the program is equal to the net price (which goes to the formula manufacturers) plus the retail markup (which goes to food retailers):

$$\text{Cost to WIC (per-unit)} = \text{Net Price} + \text{Retail Markup}$$

Increased breastfeeding rates among WIC participants, or among the U.S. population in general, could potentially lead to a change in the wholesale price of formula, the per-unit rebate, or the retail

⁵⁴For example, if the percentage discount of a contract is 92 percent, the wholesale price that the manufacturer receives for a container of nonrebated formula is over 12 times greater than the net price received for a container sold to a WIC participant.

markup. Changes in any of them could, in turn, affect the cost to WIC per unit of infant formula and therefore WIC's overall program costs.⁵⁵

Effects on the wholesale price:

- **Cost of production.** Infant formula manufacturers have large, capital-intensive plants that may exhibit large fixed costs in the short run and economics of scale (over a wide range of production) in the long run. An increase in breastfeeding rates to medically recommended levels (treated in the study as a breastfeeding rate of 90 percent for 12 months, with no infant formula) will substantially decrease demand for formula, resulting in lower quantities sold. Such a decrease in demand could have a considerable impact on a manufacturer's ability to operate at or near optimal capacity. Operating existing plants at less than their optimal level results in higher per-unit cost of production, which in turn could be expected to increase wholesale prices. Even in the long run, with an opportunity to re-scale plant size, wholesale prices may increase due to increased costs of production (per unit).
- **Market concentration.** The infant formula market is highly concentrated. In 2008 (the most recent year for which data are available), the three largest formula manufacturers accounted for 98 percent of all dollar sales (Oliveira et al., 2011). Reduced sales and higher production costs resulting from increased breastfeeding rates could lead to one or more of these manufacturers leaving the domestic infant formula market.⁵⁶ Fewer manufacturers reduces competition which could lead to higher wholesale prices.
- **Price sensitivity.** If overall breastfeeding rates in the United States increased to 90 percent with no infant formula, most of the non-WIC mothers purchasing formula out-of-pocket would be very insensitive to price because they are either unable to breastfeed or have a very strong preference to formula feed. In addition, WIC mothers who receive formula are price insensitive because they receive formula at no charge to them. If price-insensitive mothers become the predominant group in the market, infant formula manufacturers have an economic incentive to increase wholesale prices.

Effects on the rebate:

- **Number of formula-fed WIC infants.** If breastfeeding rates among WIC infants increased without a corresponding increase among non-WIC infants, the number of infants consuming the WIC brand of formula would decrease as would WIC's share of total infant formula sales. As a result, retailers would have less incentive to devote extra shelf space to the WIC brand. With less spillover effects realized by winning the WIC market, manufacturers would have less incentive to offer large rebates in order to win the WIC contracts and rebates would decrease, or possibly end altogether.

⁵⁵Infant formula manufacturers—not WIC State agencies—set wholesale prices and the amounts of the rebates they offer to WIC in bids for the contract. WIC has some influence over the retail markup of WIC-authorized infant formula through WIC's vendor peer group system, competitive price criteria, and allowable reimbursement levels (74 Federal Register, No. 194, October 8, 2009, pp. 51745-51759).

⁵⁶The exit of an infant formula manufacturer from the market is not unprecedented. For example, after many years of producing infant formula for the U.S. market, Wyeth—one of the larger formula manufacturers—phased out production of its infant formulas for the domestic market in 1996 (Oliveira, et al., 2004).

- **Number of formula-fed non-WIC infants.** On the other hand, as breastfeeding rates among WIC infants increases, so, too, might breastfeeding rates among non-WIC infants, reflecting a large societal move toward increased breastfeeding. If breastfeeding rates among WIC and non-WIC infants increased in tandem, WIC infants would continue to account for a large percentage of formula feeders even though overall demand for formula is decreasing. Under this scenario, winning the WIC market would continue to result in a large share of infant formula's shelf space being devoted to the WIC brand of formula (resulting in a spillover effect),⁵⁷ and formula manufacturers may continue to offer large rebates in order to win the WIC formula contract and maintain sales volume (or minimize their loss of sales volume) in the face of a shrinking market for infant formula.
- **Number of infant formula manufacturers that bid on WIC contracts.** Since the mid-1990s, only the three largest infant formula manufacturers—Mead Johnson, Abbott, and Nestlé (now Gerber)—have held rebate contracts. If one of these manufacturers left the domestic market due to increased breastfeeding rates and reduced sales and profitability, the bids of the remaining manufacturers could become less competitive because they would know that they now only have to outbid one manufacturer (instead of two) to win the WIC infant formula contract (Davis and Oliveira, 2015). A decrease in the number of infant formula manufacturers that bid on WIC contracts could result in lower rebates and increased costs to WIC.
- **Price-cost margins.** The overall effect on price-cost margins due to a shrinking market is difficult to anticipate because both wholesale price and costs of production (per unit) can change. Higher (lower) price-cost margins could increase (decrease) the manufacturers' incentive to offer large rebates to WIC.

Effect on retail markup:

- **Price sensitivity.** If overall breastfeeding rates in the U.S. increased to 90 percent, mothers who continue to purchase infant formula would be those who are relatively insensitive to price (see Appendix D section on “Effects on the wholesale price”). Increasing the proportion of price-insensitive customers in the market provides an economic incentive to food retailers to increase their retail markup of formula (including the WIC brand), resulting in higher costs to WIC.⁵⁸

In summary, the effect that increased breastfeeding rates would have on the per-unit cost of infant formula to WIC depends on wholesale prices, retail markups, and rebates. These components of per-unit costs to WIC depend, in turn, on several other factors, such as costs of production, market concentration, price sensitivity, and spillover effects. The magnitudes of changes in these various factors, the interplay among them, and their combined effect on per-unit costs to WIC are unknown. Most, but not all, of the possible scenarios described above could contribute to increased cost per-unit of infant formula to WIC.

⁵⁷Note that with a reduction in overall infant sales, total shelf space in stores that is allocated to infant formula may decrease.

⁵⁸Under current conditions, market forces limit the prices that food retailers charge for the WIC contract brand of formula. WIC-authorized food retailers typically serve both WIC and non-WIC customers. If any one retailer charges an above-market price for WIC foods, the non-WIC customers—those who pay out of pocket for their food—have an incentive to shop at another store. However, if both non-WIC and WIC purchasers of infant formula are price insensitive (e.g., if overall breastfeeding rates increase to 90 percent with no infant formula), there is less economic incentive to the store to keep retail markups low.

Appendix E. Descriptions of the 14 Health Outcomes in the USBC Calculator

The USBC calculator includes 14 health outcomes examined by Bartick et al. (2017). These outcomes were selected for study because they exhibit robust evidence for an association with breastfeeding and they apply to the U.S. population. Unless otherwise cited, the definitions below are drawn from disease-specific web pages of the Centers for Disease Control and Prevention.

Pediatric Outcomes

Acute lymphoblastic leukemia (ALL) is a type of leukemia, which is “a cancer of the bone marrow (the soft, sponge-like tissue in the center of most bones that makes blood cells) and blood.” Lymphoblastic leukemia is “when the body makes too many of a certain kind of white blood cells.” The term “acute” means that the cancer progresses quickly.

Crohn’s disease is a type of “chronic inflammation of the gastrointestinal tract ... Inflammation affects the entire digestive tract in Crohn’s disease.”

Ulcerative colitis is a type of “chronic inflammation of the gastrointestinal tract” in which inflammation affects “only the large intestine (also called the colon).”

Ear infections can generally affect either the ear canal or the middle ear. “Middle ear infections are called *Otitis Media*.” The USBC model focuses on acute otitis media (Stuebe et al., 2017, p. 5).

Gastrointestinal illnesses (GI) refers to gastrointestinal infections (Stuebe et al., 2017, p. 5).

Obesity is measured only among non-Hispanic White children in the USBC calculator (Stuebe et al., 2017, p. 5); that subgroup focus reflects previous work in Bartick et al. (2017) which, based on findings of earlier studies, “included a breastfeeding-associated reduction in obesity among non-Hispanic White children only” (Bartick et al., 2017, p. 2).

Lower respiratory tract infection (LRTI) is measured for cases requiring hospitalization (Stuebe et al., 2017, p. 5).

Necrotizing enterocolitis (NEC) is “the pre-eminent gastrointestinal tract disease encountered in the neonatal intensive care unit. It is an important cause of neonatal death and is the leading cause of emergency surgical treatment in newborns.” (Weimer, 2001, p. 8)

Sudden infant death syndrome (SIDS) is one of three types of sudden unexpected infant death (SUID). SUID is “the death of an infant less than 1 year of age that occurs suddenly and unexpectedly, and whose cause of death is not immediately obvious before investigation.” In SIDS, “[t]he sudden death ... cannot be explained after a thorough investigation is conducted, including a complete autopsy, examination of the death scene, and a review of the clinical history.”

Maternal Diseases

Breast cancer is “a group of diseases that affect breast tissue.”

Diabetes is a chronic disease “that affects how your body turns food into energy.” The USBC calculator is based on type 2 diabetes; the Bartick et al. model “excluded type 1 diabetes, because a recent pooled analysis demonstrated only a weak association with infant feeding” (Bartick et al., 2017, p. 2). “With Type 2 diabetes, your body doesn’t use insulin well and is unable to keep blood sugar at normal levels. ... It develops over many years and is usually diagnosed in adults (though increasingly in children, teens, and young adults).”

Hypertension is another name for high blood pressure, “which increases the risk for heart disease and stroke.”

Myocardial infarction is another name for a heart attack, which “occurs when a part of the heart muscle doesn’t receive enough blood flow.”

Pre-menopausal ovarian cancer. “Ovarian cancer is a group of diseases that originate in the ovaries or in the related areas of the fallopian tubes and the peritoneum.”

Appendix F. Applying the U.S. Breastfeeding Committee Calculator to WIC Households

The USBC calculator is based on a dynamic simulation model because some of the 14 diseases affected by breastfeeding emerge for the mother or child some years after the child’s infancy.⁵⁹ In our application, the model considers a simulated cohort of females, all of whom are 15 years old in 2006, and follows them through (simulated) time.⁶⁰ As the females grow older, any one of them may die and exit the cohort based on age-specific death rates. Those who survive may have one or more children, may decide to breastfeed, and may develop a maternal disease either in the year following birth or in a later year. At the same time, the model follows the simulated infants through childhood, tracking the probabilities that some develop a pediatric disease. The costs of diseases in future time periods are discounted to allow for the time value of money. In the model, estimates of nominal (i.e., unadjusted for inflation) costs, which are taken from the economics and health literatures, are kept constant—neither inflated in future years to reflect price inflation nor reduced due to, say, a hypothetical improvement in medical technology. The model’s 2-percent discount rate can be interpreted as a real (or inflation-adjusted) discount factor for these (constant) nominal costs.

The model’s results for cost savings are based on a three-step process. First, the model examines a “suboptimal arm,” which is based on probabilistic time paths of health outcomes and costs of disease based on six 2016 estimated breastfeeding rates for WIC mothers—initiation (78.3 percent), exclusive breastfeeding in hospital (66.9 percent), exclusive breastfeeding at 3 months (39.9 percent), exclusive breastfeeding at 6 months (19.7 percent), any breastfeeding at 6 months (44.7 percent), and any breastfeeding at 12 months (25.8 percent).⁶¹ From the time paths, the model estimates the expected discounted cost of a disease for the suboptimal arm.

Second, the model examines the probabilistic time paths of an “optimal arm,” which is based on “optimal” breastfeeding rates of 90 percent of women exclusively breastfeed each of their children for 6 months and continue to breastfeed for 12 months (Stuebe et al., 2017, pp. 1-2). From these time paths, the model estimates the expected discounted cost of a disease for the optimal arm. Third, the difference in the expected discounted cost of the two arms can be expressed as the cost of suboptimal breastfeeding or the savings in moving from 2016 to medically recommended breastfeeding rates.

Because the model’s estimate of the economic benefit of increased breastfeeding (to medically recommended levels) is calculated as the difference between two other expected discounted values for the two arms, that estimate is also an expected discounted value. As such, the estimate of the economic benefit of increased breastfeeding is best interpreted as a lump-sum value, which is achieved just once. The model’s estimate of about \$9.1 billion in cost savings is a (discounted) *total* of savings from all future years over the lifetime of the cohort of 15-year-old females under study—

⁵⁹For example, the changes in the number of cases of breast cancer may not be apparent until decades after a change in breastfeeding occurred. Similarly, reductions in childhood obesity occur after infancy is passed.

⁶⁰In Bartick et al. (2017), the simulation model considers a cohort of females who are 15 years old in 2002. Our study considered a cohort of females who are 15 years old in 2006, which dovetails with our updating and projection of breastfeeding rates to 2016 estimates. Bartick et al. (2017) had used breastfeeding rates from 2012.

⁶¹The 2016 estimates were obtained by fitting linear time trends to NIS data for 2009-15 and extrapolating 1 year beyond 2015 data. The seven estimated trends fit the data well, with R-square values of 0.98, 0.95, 0.98, 0.94, 0.91 and 0.83. The study considered expanding the model to allow for first-order autoregressive errors, but preliminary work suggested there would be little if any practical difference in the 2016 estimates using a more complex model.

not a figure of *annual* savings for the cohort. However, the simulation was specified for a single cohort of females who are 15 years old in a particular year (2006). In a simulated steady state, there is an identical cohort of females who become 15-year olds in each successive year. By generalization, each of those cohorts that follow 2006 would also have estimated cost savings of \$9.1 billion. Thus, the \$9.1 billion estimates represents annual savings when many cohorts are considered and breastfeeding rates are sustained at medically recommended levels for each of them.

The economic concept of the *value of a statistical life* is central for measuring the cost of early death, which is a topic that is controversial both in principle and in application. Importantly, the value of a statistical life does not refer to the value of any single identifiable person (Boardman et al., 1996, p. 314). Instead, the value refers to a typical person in a population of people all of whom face a change in risk to life. A market-based approach to measuring the value people place on changes in risk to life are based on wage premiums in the labor market for accepting a riskier job at a higher wage or price premiums for increased product safety (e.g., purchasing a safer car at a higher price) (Boardman et al., 1996, pp. 314-316). The Bartick et al. model, which underlies the USBC calculator, used estimates for the value of a statistical life from Aldy and Viscusi (2007) that were based on wage premiums and varied across ages, equaling about \$12 million (in 2016 dollars) for a statistical life for those less than 25 years of age and falling to about \$3 million for those over 62 years of age (Bartick et al., 2017, p. 6).

The USBC calculator is designed to follow a (simulated) cohort of 15-year-old females who have breastfeeding rates equaling U.S. estimates or a user-defined set of breastfeeding rates. Our study applied the calculator to “*WIC households*,” which consists of WIC infants, and their mothers—regardless of whether the mothers participate in WIC themselves.

Our study applied the USBC calculator to the WIC households by specifying: (a) the number of births of WIC infants as 47.5 percent of all 2016 births in the calculator, based on the WIC infants as a share of U.S. births; (b) the number of 15-year-old females that at some time in their lives will be part of a WIC household (a mother of a WIC infant) as 47.5 percent of all 15-year-old females in 2006; (c) the medically recommended level of breastfeeding to be 90 percent, and (d) estimated 2016 breastfeeding rates for the WIC population using 2009-15 data from the National Immunization Survey conducted by the Centers for Disease Control and Prevention.

Appendix G. Sensitivity Analysis

As described in the main text of this report, this study estimated the effects of a hypothetical increase in breastfeeding rates among WIC infants on: (1) WIC participation; (2) Federal program costs (i.e., WIC and Medicaid costs); and (3) health-related costs. The results reflect the difference in effects that arise from two different scenarios: (1) breastfeeding rates are at their 2016 levels; and (2) breastfeeding rates reach medically recommended levels defined in this study as 90 percent of infants are breastfed for 12 months, with no infant formula.

Breastfeeding rates in WIC would have to increase dramatically to reach medically recommended levels. For example, while the medically recommended level for breastfeeding at 6 months was 90 percent, in 2015 (latest available year of data), only 44.5 percent of infants receiving WIC benefits were breastfed at 6 months (U.S. Department of Health and Human Services, no date, c). This raises questions about the likelihood that medically recommended breastfeeding rates will be achieved in the near future given the current level of investment in breastfeeding promotion and support activities.

A sensitivity analysis was conducted to determine how much results change—in other words, their degree of sensitivity—when certain changes are made in the study’s underlying assumptions. Specifically, we estimated the effects on WIC participation, Federal costs, and health-related costs under three alternative scenarios (appendix table G-1). Two of the scenarios—*Healthy People 2020* and *Mid-point*—were based on more modest increases in breastfeeding rates than under the scenario based on medical recommendations.

Appendix table G-1

Scenarios included in the sensitivity analysis

Scenario:	Assumption
Medically recommended	90 percent of infants are breastfed for 12 months, with no infant formula
Healthy People 2020	Breastfeeding rates reach the goals specified in Healthy People 2020, a set of achievable 10-year goals and objectives for improving the health of all Americans (CDC, no date)
Mid-point	Breastfeeding rates lie halfway between the Healthy People 2020 rates and the medically recommended levels
Alternative medically recommended (w/partial breastfeeding)	90 percent of infants are exclusively breastfed for their first 6 months, followed by both breastfeeding and formula feeding (i.e., partial breastfeeding) for months 7 through 12

Source: USDA, Economic Research Service.

A third scenario isolated the effect of partial breastfeeding among WIC participants. The AAP and other U.S. health organizations do not have recommendations on whether continued breastfeeding between 6 and 12 months includes supplementing the breastmilk with infant formula. Under the medically recommended scenario discussed in the main text, it is assumed that infants do not receive any infant formula during their first year. Therefore, to determine the effects on costs and participation associated with partial breastfeeding after 6 months of age, the *Alternative medically recommended with partial breastfeeding* scenario assumed that 90 percent of infants are exclusively breastfed for their first 6 months, followed by both breastfeeding and formula feeding for months 7 through 12.

Effects were estimated by comparing the differences in WIC participation, Federal program costs, and health-related costs under each of the alternative scenarios (and, for comparison purposes, under the *Medically recommended* scenario described in the main text) to those based on 2016 breastfeeding levels. To implement the sensitivity analysis, estimates of cost savings for health-related costs using the USBC calculator required six breastfeeding rates: any breastfeeding at 0, 6, and 12 months and exclusive breastfeeding at 0, 3, and 6 months (appendix table G-2).

To obtain estimates of the effects on participation and costs to the WIC program, the sensitivity analysis required mid-month estimates, under each scenario, of the number of infants by age (0.5 through 11.5 months) and the number of mothers by months post-partum (0.5 through 11.5 months) who receive each type of food package (fully breastfed, partially breastfed, or fully formula fed). The food package estimates depended on mid-month estimates of any, exclusive, and partially breastfeeding rates under each scenario:

- For the *Healthy People 2020* scenario, mid-month exponential regressions were fit to the data in appendix table G-2 on breastfeeding rates in that scenario.⁶²
- For the *Mid-point* scenario, the mid-month breastfeeding rates were estimated as a set of month-specific averages of the *Healthy People 2020* and the *Medically recommended* scenarios.
- For the *Alternative medically recommended with partial breastfeeding* scenario, the mid-month breastfeeding rates are 90 percent of infants are exclusively breastfed for their first 6 months followed by both breastfeeding and formula feeding for months 7 through 12.

Appendix table G-2

Breastfeeding rates under the various scenarios

Type of breast-feeding	Child age	2016 levels	Medically recom- mended	Healthy People 2020	Mid-point	Alternative medically recommended (w/partial breastfeeding)
Any	At birth	78.3	90	81.9	85.95	90
	6 months	44.7	90	60.6	75.30	90
	12 months	25.8	90	34.1	62.05	90
Exclusive breastfeeding	At birth	66.9	90	70.3	80.15	90
	3 months	39.9	90	46.2	68.10	90
	6 months	19.7	90	25.5	57.75	0

Notes: Healthy People 2020 does not provide an explicit goal for the exclusive breastfeeding rate at 0 months. The rate of 70.3 for the Healthy People 2020 scenario was calculated as the product of the goal for any breastfeeding (81.9 percent) and the complement of the proportion of breastfed newborns who receive formula within the first 2 days (given by $(100 - 14.2 \text{ percent})$). The medically recommended scenario has breastfeeding rates derived directly from the scenario's description. The rates for the Mid-point scenario are each a simple average.

Source: USDA, Economic Research Service calculations based on data from USDA, Food and Nutrition Service and CDC, no date b.

⁶²Using the estimated equations, mid-month breastfeeding estimates were obtained for 0.5 to 6.5 months as described in Appendix B. For months 7.5 to 11.5, the estimated exponential equation yielded estimates below 2016 breastfeeding rates. Therefore, we added 4 percentage points (the difference at 6.5 months between the regression-based estimated rate and the 2016 breastfeeding rate) to the regression-based estimates to obtain the final, mid-month estimates for months 7.5 to 11.5.

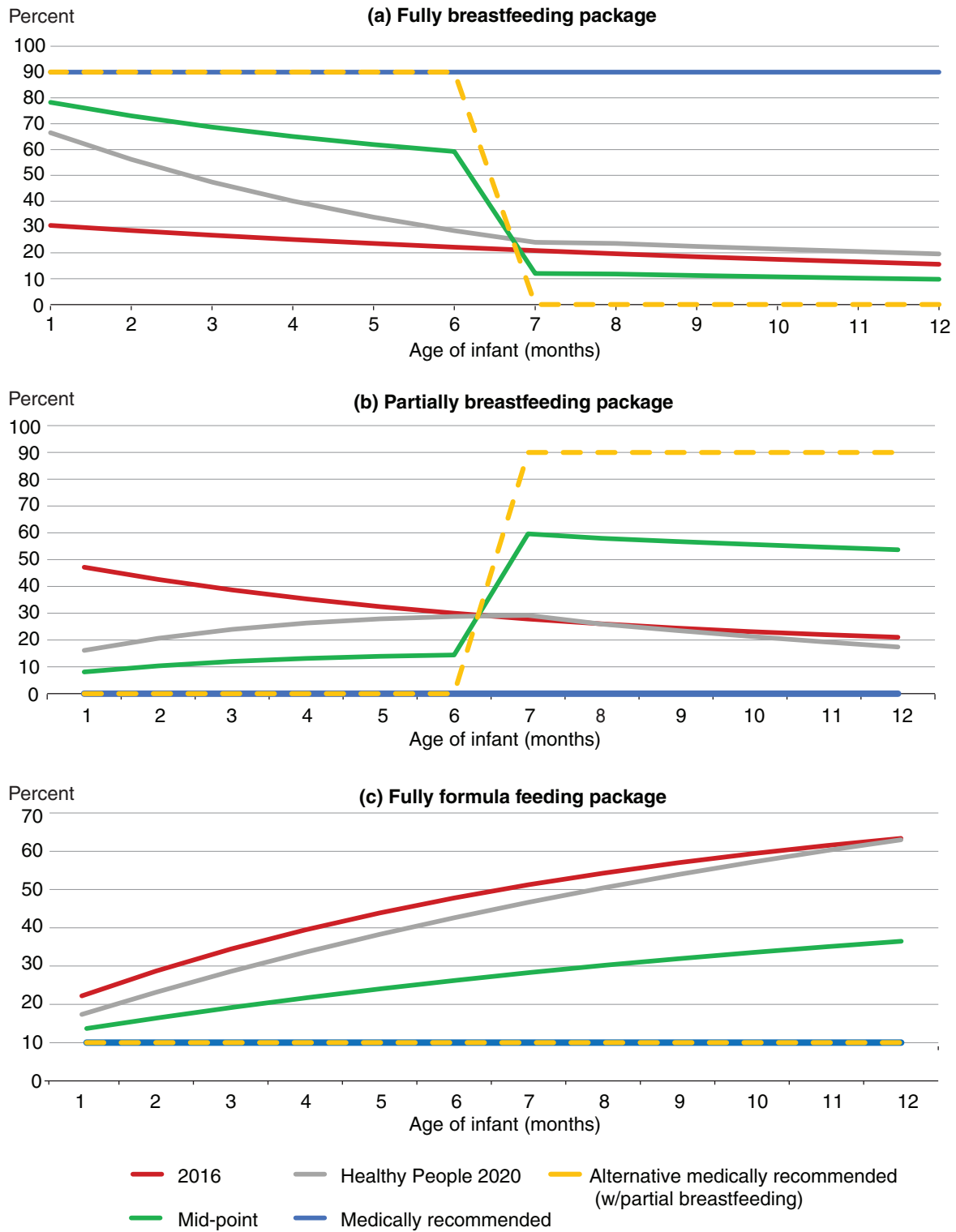
Under each scenario, partially breastfeeding rates were estimated as the difference between the any breastfeeding and exclusive breastfeeding rates.

We used these mid-month estimated breastfeeding rates to obtain mid-month estimates of the number of infants and mothers by type of food package where exclusive breastfeeding proxied for the fully breastfeeding food package, partial breastfeeding proxied for the partially breastfeeding food package, and the fully formula feeding food package was derived as 100 percent minus the any breastfeeding rate. Appendix figure G depicts the estimated time-paths of proportions of infants and mothers receiving the fully breastfeeding, partially breastfeeding, and fully formula feeding food packages for each of the four scenarios, as well as the estimated 2016 proportions.

Results of the sensitivity analysis are summarized in appendix table G-3. In the *Healthy People 2020* and *Mid-point* scenarios (both of which involve an increase in the breastfeeding rates compared to 2016 rates), WIC program costs and average monthly participation increase. Federal Medicaid costs decrease in both scenarios, but by less than the increase in WIC program costs, resulting in an increase in total Federal costs. At the same time, health-related costs decrease in both scenarios, resulting in savings to WIC households or their insurers. However, the specific effects on participation and costs varied widely across the two scenarios.

- *Healthy People 2020*. Under this scenario, the percentage increase in average monthly participation in WIC (3.6 percent) and total WIC costs (1.6 percent) are modest relative to each of the other scenarios. Similarly, the increase in total Federal costs and the decrease in health-related costs are the smallest among the various scenarios. These findings are expected given that the Healthy People's targets—which are considered to be challenging yet achievable—with regard to breastfeeding are relatively close to current breastfeeding levels.
- *Mid-point*. Under this scenario, the effects on WIC participation and the various costs are greater than those under the *Healthy People 2020* scenario but less than those under the *Medically recommended* scenario. This is not surprising given that the various breastfeeding rates under the *Mid-point* scenario lie halfway between the *Healthy People 2020* and *Medically recommended* rates.

Estimated proportions of WIC infants and mothers, by food package type and age of infants/months post-partum



Note: WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.
 Source: USDA, Economic Research Service calculations based on data from USDA and CDC, no date b.

Sensitivity analysis results: Estimated effects of increased breastfeeding rates in WIC under different hypothesized scenarios, 2016

Scenarios	Change relative to 2016 breastfeeding rates						
	Average monthly WIC participation		WIC costs		Federal Medicaid costs	Total Federal costs	Health-related costs
	<i>Number</i>	<i>Percent</i>	<i>Million dollars</i>	<i>Percent</i>	<i>Million dollars</i>	<i>Million dollars</i>	<i>Million dollars</i>
Healthy People 2020	280,395	3.6	\$94.1	1.6	-\$16.1	\$78.0	-\$2,417.2
Mid-point	463,107	6.0	\$173.3	2.9	-\$63.8	\$109.5	-\$5,742.8
Medically recommended	645,811	8.4	\$252.4	4.2	-\$111.6	\$140.9	-\$9,068.5
Alternative medically recommended w/partial breastfeeding	642,720	8.4	\$167.4	2.8	-\$111.6	\$55.8	-\$9,068.5

WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Source: USDA, Economic Research Service.

The third scenario looks at the effect of partially breastfeeding (instead of fully breastfeeding) after 6 months:

- *Alternative medically recommended with partial breastfeeding.* Under this scenario, the effect on WIC participation and on health-related costs was similar to that under the *Medically recommended* scenario.⁶³ However, the increase in WIC program costs (and therefore total Federal costs) was much less. Specifically, total WIC costs and total Federal costs were both \$85.1 million less than under the *Medically recommended* scenario. This decrease is due primarily to the food packages for partially breastfed mothers being almost 23 percent less expensive than the food packages for fully breastfed mothers, and under this scenario, more mothers are partially breastfeeding and less are fully breastfeeding. Holding other factors constant, moving WIC participants from fully breastfed to partially breastfed after 6 months would result in lower WIC costs and therefore, lower Federal costs.

In summary, the results of the sensitivity analysis indicate that increasing breastfeeding rates among WIC participants would increase WIC participation and WIC and total Federal costs, while decreasing health-related costs to WIC households or their insurers. However, the magnitude of these effects varies depending on the degree to which the breastfeeding rates increase and on the ratio of fully breastfeeding to partial breastfeeding participants.

⁶³Note that the estimated average number of monthly participants was slightly less under the Alternative medically recommended with partial breastfeeding scenario compared to the Medically recommended scenario. This was because—as discussed in Appendix A: Estimating the Number of Participants If Breastfeeding Rates Increased to Recommended Levels—the estimated number of breastfed mothers who would participate under the various scenarios is based on the ratio of breastfed mothers to breastfed infants in FY 2016. FNS administrative data indicate that the ratio of partially breastfeeding WIC mothers to partially breastfed WIC infants on a monthly basis in 2016 was 99.5 percent (appendix table A). The ratio of fully formula-feeding mothers to fully formula-fed infants was 99.8 percent. The estimates of Federal Medicaid costs and health-related costs are unaffected by whether breastfeeding after 6 months of age is exclusive or partial.