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Abstract: Several key studies highlight the importance of breastfeeding and there is a broad consensus that it plays a crucial role for a child's health and cognitive development. This is especially true for the poor in developing countries, where vulnerable infants' access to proper nutrition is vital. We investigate the effect of introducing infant formula into a market on changes in breastfeeding patterns. Using the Demographic Health Surveys and annual reports from the baby food industry between 1981 and 2002 in 11 tropical countries, we find evidence that import of infant formula significantly reduces breastfeeding duration. The effects are stronger in areas where breastfeeding rates generally are higher, that is, in rural areas, among women with low education and among women that do not work full time.

1. Introduction

This paper investigates the effect that the infant formula industry has had on changes in breastfeeding behavior in the developing world. Due to the clear benefits of breastfeeding and the risks related to the use of infant formula, there have been controversies associated with the infant formula industry ever since its emergence in the early 1900s. Today, there is overwhelming evidence that breastfeeding is the optimal choice for children under 6 months (World Health Organization, 2013), as it plays an important role for children's health and cognitive development. Breastfeeding has shown to give immunological benefits such as developing important antibodies, which are essential for the child's development (Jayachandran & Kuziemko, 2009). Furthermore, breastfeeding reduces the chance that infants will come in contact with contaminated food and water (Mason et. al, 2013). Use of infant formula, the general substitute for breastfeeding, can create great health risks in areas with poor sanitation where formula is mixed with water that is unclean and contains high bacterial levels, which can increase the risk of diarrhea and other diseases that can ultimately lead to death (Meier,2009).

Switching to breastfeeding can be a method to reduce child mortality in the developing world. A 2013 report from UNICEF estimates that exclusively breastfed children are 14 times less likely to die in the first six months than a non-breastfed child. Another study by Save the Children (2013) estimates that in 2008, 1.4 million children died as a result of sub-optimal breastfeeding. Despite these risks, according to UNICEF (2013), only 39 percent of 0-5 month olds in low-income countries are exclusively breastfed. Urbanization, modernization, women entering the work force and different cultural and normative perceptions, can help explain the low breastfeeding rates. (Abada, Trovato & Lalu, 2000). In addition to these processes, the infant formula industry has played an important role. Global sales of milk formula have increased from about 2 billion dollars in 1987 to 40 billion dollars in 2013 (McFadden et. Al, 2016).

Dangers related to infant formula were initially brought to the forefront in the 1970s, when several human rights organization criticized Nestlé for aggressively and unethically promoting infant formulas, enticing mothers to switch from breastfeeding to formula, resulting in early childhood malnourishment (Sethi, 1994). Formula was marketed to poor, illiterate and those living in areas with poor sanitation, which made it difficult to prepare infant formula safely (Weimer, 2001). A world wide boycott of Nestlé finally led to the creation of the he International Code of Marketing of Breast milk Substitutes (WHO - referred to as the Code herein), which prohibits any advertising of baby formula, bottles or providing inducements (gifts or otherwise) to mothers by health workers, and by infant formula companies to health workers (Brady, 2012; WHO, 1981). Even though the Code was established more than 30 years ago, continued violations occur. In 2009, over 500 violations of the Code in 46 countries were reported (Kean & Allain, 2010). The Code is not legally binding unless it is incorporated into a country's national law (Mason et. al, 2013). A report form WHO (2013) emphasize that only 37 out of 199 countries have passed laws reflecting all the recommendations of the Code. This makes the enforcement of the code a delicate and matter.

Although the baby food industry is often blamed for breastfeeding behavior changes and the resultant negative child health effects (Muller, 1974), few papers have investigated the causal relationship between infant formula introduction and breastfeeding behavior at a population level. Making a causal argument is difficult because of the endogenous nature of breastfeeding behavior. Using exogenous variation in the infant formula industry's market choice, we make the case that breastfeeding changes were a result of this shock, and examine the impact of Nestlé, the largest global infant formula producer and distributer, on mothers' breastfeeding behavior in 11 developing countries. Using market entry dates from Nestlé's annual reports and breastfeeding data form the Demographic Health Surveys (DHS) from 1981, we use an event study to measure the impact of Nestlé's infant formula imports (shock) on breastfeeding duration in a country.

Including various relevant controls and fixed effects, we find that import of infant formula significantly reduces the months a mother breastfeeds her child, increasingly each year after Nestlé begins importing infant formula. The effect is more pronounced in rural areas where women are less educated and don't work full-time, which indeed contradict findings in previous literature.

The paper is organized as follows: Section 2 explains previous research on the primary benefits of breastfeeding, followed by an investigation of the barriers to breastfeeding and what role the infant formula companies has related to this; Section 3 presents the data and Section 4 describes the methodology and provides the main results.

Finally, Sections 5 offers policy implications, insights into to the findings and ideas for moving forward.

2. Literature Review

2.1 Health Effects, Benefits and Burdens

Breastfeeding is most important the first month of the child's life. The immune system is very limited as a child is born; the child is colonized with microbes from the mother's intestinal flora, which helps develop a stronger immune system. In this period the child is very vulnerable to outside microbes (Hanson & Korotkova, 2002). The mother produces milk called colostrum during this period, which helps the infant's intestines mature, containing a protective substance that makes it difficult for bacteria to attack the infants throat, lungs and intestines (Uruakpa et al, 2002). Edmond et. al. (2006) estimates that around 22 percent of neonatal death could have been avoided if children were breastfed within an hour after birth.

UNICEFs (2013) and WHOs (2013) recommend that children should be breastfed within the first hour of birth, exclusively breastfed for the first six months thereafter, and then in combination with other foods, breastfed up to two years old. This is defined as optimal breastfeeding.

Two of the most common child diseases, diarrhea and pneumonia, can be eliminated or lessened with optimal breastfeeding (César et. al., 1999; Sokol et. al., 2007). These two illnesses can result from contaminated water or food that contains parasites or bacterial (Mason et. al, 2013). Indeed, several studies have found this to be true. Feachem and Koblinsky (1984) review over 30 studies conducted in 14 developing countries and find overwhelming evidence that breastfeeding reduces risk of diarrheal disease. Perera et. al. (1999) finds exclusive breastfeeding for at least 4 months, significantly reduces the risk of respiratory and diarrheal illnesses of Sri Lankan infants. A Brazil case-control study suggests infants who were not breastfed were 17 times more likely to be admitted to hospital for pneumonia than those being breastfed without infant formula milk (César et. al., 1999). A WHO (2009) report found that non-optimal breastfed children have a higher risk of asthma, diabetes, and Crohn's disease.

Besides preventing disease and infection, not breastfeeding can increase other health risk factors and decrease cognitive functioning, comparatively. Using infant formula as a substitute can lead to a higher risk of childhood and adolescent obesity. Breastfeeding is associated with significantly greater cognitive development for children, evidenced by higher test scores, than children using infant formula (Anderson et. al., 1999).

In addition to health risks and disease burden related to infant formula use, when households lack sufficient sanitation equipment, a great economic burden is placed on them to ensure infant formula is not contaminated. A Philippines study concludes around one third of families living on under $2 a day purchase infant formula (Sobel et. al, 2012), which implies the costs of using formula could substitute away from other childhood investments like education and social services. Kent (2015) notes that low-income families in Singapore spend about half of their monthly food expenditures on infant formulas. To offset costs families may dilute formula (Andersen et. al., 2007; Surjono et. al., 1980), which can further reduce the limited, essential nutritional offering in infant formula.

Despite the overwhelming short and long-term benefits of breastfeeding and the high costs and risks related to infant formula, a large gap between current practice and accepted recommendations remains (WHO, 2013). Although a large effort to promote breastfeeding, both internationally and nationally, has been underway, trend data suggests that the exclusive breastfeeding among children under 6 months in developing countries increased only by around 6 percent (from 33 – 39 percent) between 1995 and 2010 (Cai et. al., 2012).

2.2 Determinants to Breastfeeding Behavior

2.2.1 Global and Demographic Trends

Wide variation of breastfeeding adoption exists among countries. In Africa, breastfeeding up to 24 months is common, while early initiation[1] is highest in Latin America (Black et. al, 2013). West and Central Africa exclusive breastfeeding increased the most in the last 20 years (Cai et. al., 2012), while East Asia and the Pacific, which traditionally have

[1] Breastfeeding within an hour after births.

had high breastfeeding rates (Bareness et. al., 2012), now report sharp decreases in exclusive breastfeeding rate, UNICEF (2012) finds that exclusive breastfeeding declined by 29% in 2012. The baby food industry allocates most of its resources to East Asia and the Pacific region (Mason et al., 2013). Breastfeeding rates, however, are the lowest in Eastern Europe (Black et. al, 2013).

In general, there is a strong correlation between infant formula and modernity (Abada, Trovato & Lalu, 2000; Grummer-Strawn, 1996). Save the Children (2013) examined 44 countries with high infant mortality rates using DHS data, and noted that higher levels of education and high-income household are associated with lower rates of exclusive breastfeeding. Abada, Trovato & Lalu's (2000) Philippines study mirrored these results, but they also discovered that women involved in professional positions have a higher probability of shorter breastfeeding duration than women in agriculture or low skilled labor. Birth order changes the rate of breastfeeding: seventh or higher order children were roughly twice as likely to be breastfed than firstborn children, even when controlling for socioeconomic and demographic variation (Grummer-Strawn, 1996). Jayachandran & Kuziemko (2009) indicate in their data that daughters are weaned earlier than sons, and children with few older siblings are weaned earlier. Breastfeeding has contraceptive effects, because breastfeeding prevents production of the ovulation hormone (Blackburn, 2007). The authors suggest a desire to have more children, especially boys, leads to breastfeeding reduction to induce pregnancy.

2.2.2 Barriers to Breastfeeding

Breastfeeding behavior is determined by a number of social, psychological and cultural factors separate from promotion and availability of infant formula. Although rural and low-income households breastfeed longer, they tend to start later (Mason et. al. 2013). A Nigerian study links traditional belief that are suspicious about colostrum milk because of its color with reduction in breastfeeding, and often it is mixed with infant tea and water (Davies-Adetugbo, 1997). Many poor women have a commonly held beliefs that their milk is not sufficient (Agunbiade & Ogunleye, 2012), and similarly, many others believe bottle-feeding is good (Winikoff & Laukaran, 1989). Consequently, these women may choose to supplement breastfeeding with infant formula or other substances as a nutrition booster to breast milk. However, this intermingling of breast milk with other substances through chemical reactions can reduce breast milk quality and inhibit duration of breastfeeding (Bareness et. al., 2012).

Of course, some women are simply physically not able to produce breast milk and infant formula is necessary; others just may struggle with the process (physically or otherwise), and so, midwives and other health workers plays significant roles in supporting new mothers, providing guidelines and advise about the best practices in breastfeeding (Mason et. al. 2013). Unfortunately, not all health workers are informed about breastfeeding, and some even encourage infant formula (Mason et. al. 2013; Bareness et. al., 2012). To further complicate this issue, some local doctors lack motivation to educate mothers because of the additional time component needed. This becomes a larger concern when local doctors are incentivized by the infant formula industry due to the under table practices (S. Mukherjee, head of the neonatology department, SSKM hospital, Kolkata, personal communication, July 14, 2015).

While breastfeeding is generally free and safe, it is more time consuming; and thus less compatible with work than formula feeding (Rippeyoung & Noonan, 2012). Workforce conditions and labor laws protecting women also impact breastfeeding behaviors. Women working in urban settings, such as factories, are often required to stay long hours, often far from home (Abada, Trovato & Lalu, 2000). In a study from a large Taiwanese semiconductor manufacturer, among women returning to work after giving birth, only 10 percent continued to breastfeed, mostly as a result of an inconvenient working environment for breastfeeding (Chen & Chie, 2006). The International Labor Organization (ILO) has advocated for maternity leave and a family friendly policy given current conditions, as they are not conducive to a child and mother's health (ILO, 2014). Despite the ILO campaign, maternity legislation and laws protecting women are not always very strong in the developing world. A Save the Children (2013) study examining 36 low-income countries, found only 10 met ILO's minimum standard of 14 weeks of maternal leave. In the informal sector, there is even less compliance, especially in societies where public breastfeeding is taboo (Mason et. al. 2013).

2.2.3 The Role of the Infant Formula Industry

Between 2008 and 2013 the infant formula industry grew by 37 percent, and almost two-thirds of the growth came from the Asia–Pacific (UNICEF, 2013). Infant formula was meant to be a specialized food when breastfeeding isn't feasible, but is has become a multi-billion industry worldwide and is now marketed as a normal infant food (McFadden et. al., 2016). Nestlé emphasizes they don't compete with breastfeeding and that promotion is only targeted at mothers using competitors' formula (Sethi, 1994); they contend breast milk is ideal, emphasizing infant formula usage for mothers that can't breastfeed (Nestlé, 2016). As a result of the worldwide boycott in the 1970s, Nestlé changed its organizational structure and undertook a stronger Corporate Social Responsibility (CSR) approach, among other things, creating the Nestlé Coordination Center for Nutrition (NCCN) in 1981. The NCCN is charged with ensuring it operates within WHO guidelines, that employs truthful marketing practices and that strong quality controls for infant formula exist (Sethi, 1994; Nestlé 2015).

Despite these instituted safeguards, studies provide evidence of continued infant formula promotion among breastfeeding women, lack of breastfeeding education among mothers and concurrent increases in infant formula consumption. Winikoff & Laukaran (1989) investigated how mothers learn about bottle-feeding in four different developing countries via qualitative interviewing. Interestingly, four key beliefs emerge: mothers think they have insufficient milk, mothers think infant formula is a viable alternative, mothers are brand conscious about infant formula, and mothers are influenced to bottle-feed via the peer effect through friends and family.

Exposure to bottle feeding is widespread. For example, in a case study in Pakistan, 84% mothers were advised to use formula for infants under six months, and over half of this advice came from health workers (Mason et. al. 2013). In another study tracking violations of the Code in Bangkok, 26% of mothers reported receiving free samples of breast milk substitutes and 18% of the health workers in the sample reported receiving gifts from infant formula companies (Taylor, 1998). Gilly and Graham (1988) examine the infant formula promotion effect by consumption in 79 developing countries, using macro data on infant formula imports before and after 1975, the time when many infant formula companies self-imposed a restriction on promotion by agreement. Using a one-tailed t-test they argue for a causal link between promotion and consumption of infant formula, as consumption went down after the regulation, even when controlling for several macroeconomic factors.

The use of bottle-feeding is associated consistently with early breastfeeding weaning, even if it is unintended (Winikoff & Laukaran, 1989). A survey of 345 households and three focus groups in the Philippines, (Sobel et al., 2011) indicated those using infant formula were

6.4 times more likely to stop breastfeeding before 12 months, and those that recalled industry promotion or a doctor recommendation of infant formula, were twice and four times as likely to stop breastfeeding, respectively.

This study follows other case studies by incorporating a household survey, and then examines the Nestlé infant formula promotion effect using a country level event study similar to Gilly and Graham (1988). While their study test the effect on a macroeconomic level, this study focuses on changes to country access by infant formula companies and the concomitant breastfeeding behavior at the microeconomic level (village and mother level). By employing this approach, we can measure intensity exposure by distance from the event, and not just the aggregate effect of the industry, further reinforcing the external validity of the "industry effect".

3. Data

Our empirical analysis uses the Demographic Health Surveys (DHS) from the United States Agency for International Development (USAID). The DHS preforms household surveys, interviewing both male and females in the age group 15-49 years, and contains comprehensive information about infant nutrition, breastfeeding status, duration and frequency of breastfeeding as well as information on infant health and infant mortality. Surveys also contained information about household socio-economic status, parental education, working status and sector of work, which were used as relevant controls since they may impact breastfeeding patterns directly

This paper utilize all survey rounds from the DHS (I –VI) performed from 1986 to 2011, which we have put together as a global DHS data set for all DHS countries. The data has been reshaped so that all observations are at a child level. This narrows the sample down, in the sense that only women that have given birth are part of the sample. The dependent variable in this research is the number of months a mother report having breastfed [2] her child. The questionnaire is retrospective and provides breastfeeding information up to five years before the survey, but restricts information from children born

[2] Breastfed is in this survey any type of breastfeeding; the child may or may not receive supplemental foods.

more than five years before the survey. Since breastfeeding duration is the variable of interest, all children without breastfeeding information are excluded.

The treatment variable is the year Nestlé starts importing infant formula products to a specific country. This variable is based on Nestlé's annual reports dating back to 1966, when Nestlé began reporting statistics on country penetration in their annual reports, through 2014. As mentioned previously, Nestlé S.A is the largest global producer of infant formula and owns 23% of the market share (Coriolis, 2014); therefore, Nestlé is a good proxy indicator of infant formula availability within a country.

We combine the infant formula data with the DHS data and keep the observations for countries where we have information on breastfeeding duration at a regional level both before and after Nestlé start importing to a country. This leaves us with 11 countries and 8 different entry years. In addition, the sample is limited to include only five years before Nestlé starts import and up to 5 years after in order to get a precise interpretation of the effect.

As mentioned in the literature review section, many determinants affect how long mothers choose to breastfeed her child. There will be many unobservable heterogeneous variations between each mother or each child, which are difficult to control for. To cope with this issue, we create a tighter subsample including only clusters where there are children born both before and after Nestlé start importing infant formula a specific country. The clusters are small villages where the surveys are held, that range between around 2 and 70 respondents in each cluster. The mothers within the cluster are therefor more likely to have been exposed to the same influence; they may have seen the same commercials, visited the same doctors, and received similar advices form neighbor and/or friends. Furthermore, there are reasons to believe that the mothers in the same cluster may be in quite similar socioeconomic situation, since people living in the same areas often tend to be similar in that sense. In this sample there are approximately 50,000 children.

Since there may still be personal characteristics that are unobserved in these clusters, we have created an alternative sample within the cluster sample, including only mothers that have children with breastfeeding information born both before and after Nestlé start importing infant formula to their country. This alternative sample includes approximately 17,000 children.

4. Empirical Analysis

4.1 Estimation Strategy

This event study uses Nestlé import as a proxy for strong market presence of infant formula in a specific country. Using Nestlé's base year for entry (imports into a country) into the infant formula market as a plausible exogenous shock, we attempt to explain variations in breastfeeding patterns before and after Nestlé enters the country. The data is normalized to t=0 (base year) for the first time Nestlé enters a country, where t is the years before and after the entry. The estimation strategy in this paper is based on the following OLS model:

$$y_{it} = \sum_{t=0}^{\bar{t}+5} \tau_t T_{ct} + \alpha_{ct} + \phi_i + \theta_{jt/dt} + u_t \qquad (1)$$

where y_{it} is the dependent variable breastfeeding duration. $\sum_{t=0}^{\bar{t}+5} \tau_t T_{ct}$ represents indicator variables of leads and lags in the neighborhood of Nestlé entry; T_{ct} is an indicator variable that signals market entry in country c; α_{ct} controls for idiosyncratic variation in seasonality by birth month for each specific country c. Φ_i denotes birth order by gender of child fixed effect. In order to compare children born within the same clusters, a fixed effect exploit the within-group variation is used for each cluster level θ_{dt}, where *d* is cluster and *t* is time. Similarly, we include a fixed effect for mother level, θ_{dj}, where *j* is mother and *t* is time, comparing children before and after, born by the same mother. Finally, ϕ_i, is a fixed effect for age in months when the survey was completed. Finally, standard errors were clustered at a regional level.

The breastfeeding sample suffers from a rather truncated sample, since a large fraction of children are potentially being breastfed during the survey that could potentially downward bias results. Children born after Nestlé's entry are more likely to be younger and thus, more likely to be breastfed than the children born before entry, whom are older and more likely weaned off breast milk by that time. We exclude children with breastfeeding durations equivalent to their age in months, as this will not reflect total duration in many cases. Since the samples are restricted to include only five years before and after, our omitted category and comparison group will be all the children born between the year before and five years before Nestlé's entry.

Using this mother sample provides us the most precise measure available, but it has two primary weaknesses: 1) selection bias exists by birthing frequency, since mothers with two or more children gave birth only within our sample interval (5 years before Nestle entry), and that relatively short interval may not reflect average birthing frequency 2) children born post-Nestlé entry will, by definition, be the highest birth rank in the sample, which may reflect the population of interest. By analyzing data at the natural cluster level, we mitigate some of this bias because we compare mothers with similar birthing frequency and birth order intervals. The cluster sample allows better comparisons across the larger sample.

To test the veracity of these assumptions and ensure our results are consistent, we employ several robustness checks that include different covariates and combinations, thereof (see Results). Since our identifying assumption relies on Nestlé's exogenous entry conditional on relevant covariates in the model, it must hold under a number of unique conditions and contexts, which is a rather strong ignorability assumption considering Nestlé probably doesn't make investment decisions randomly. To plausibly make this condition hold, we control for foreign direct investments (FDI) within a country using FDI net inflows, which proxies for macroeconomic environment and foreign investment openness, providing justification for " ignorability".

4.2 Results

4.2.1 Descriptive statistics

Table 1 includes the whole sample with approximately 78,000 children born and breastfed around the time Nestlé entered each of the eleven countries. Most of the mothers live in rural areas and have little education; only about 5 percent of the women have higher education. The woman's age when the child is born is widely spread, from 10 years being the youngest to 50 years being the oldest. The children are born between 1981 and 2004, giving more than 20 years of variation. The average month a child is breastfed is around 13 months, but the standard deviation is almost 2/3, meaning that there is a very large spread; many children are breastfed much less than this, and many are breastfed much longer and up to 59 month, that is, breastfed for almost five years. Breastfeeding duration varies quite within the sample; children living in rural are on average breastfed 3 months longer than children living in urban areas. Furthermore, children born to mothers with no education are on average breastfed 5 months more than children born to mothers with high education. Both which are consistent with the literature. Around 7 percent of the children are not breastfed and 29 percent are breastfed less than 6 month. These two might be upward biased due to the large share of children potentially still being breastfed (around 35 percent).

4.2.1 Main Results

There is a significant decrease in breastfeeding duration for the regional and cluster sample when analyzing data at the cluster level, and the effect becomes stronger with time. When analyzing at a regional level, there is no significant change in the after years compared to the before years, likely due to the unobservable heterogeneity within the regional sample (Table 2). Because children are most vulnerable to breastfeeding weaning in the first 6 months, we test Nestlé's impact on this probability using a binary outcome variable, and find children born 3 years after Nestlé entry are approximately 17.8 percentage points more likely to be weaned than those before entry, significant at the 1% level (Table 3).

We examine heterogonous effects by splitting the sample by social economic status (SES); region (Table 4) mother's education (Table 5) and work status (Table 6), using the cluster and mother samples. A trend of decreasing breastfeeding, post-Nestle entry, by region in both samples appears, but is only significant in the rural areas and in the cluster sample, and not significant at all in the urban demographic. In contrast to the existing literature we find uneducated or low-educated women (primary school) are most affected by Nestlé's entrance, with a sharp and significant decrease in breastfeeding duration two years after Nestlé enters (column 2) and beyond for low-educated women, and decreasing one-year post-Nestle entry for uneducated women. Similarly, higher educated women also deviate from the empirical expectation from previous literature, showing a significant increase in breastfeeding duration. Finally, given that work status is a strong determinant for breastfeeding duration we find the expected significant reduction after 3 and 4 years for women working year round; however, we continue to report results that run counter to previous empirical work, because the effect is much stronger for women that don't work or rarely work.

We examine the pre-trends to test the exogenous product placement assumption by using various leads before Nestle entry, 1-4 years pre-Nestlé entry (Table 7). Column 1 presents a negative trend overall, but with high standard errors, which is likely a result of using the full cluster sample. As we drop cluster one and the year one, we find a stronger negative trend, and this trend continues as more years are omitted: "import year – 4" in column 2, "import year -4 and -3" in column 3, and finally "import year -4, -3 and -2" in column 4. Given these pre-trends, Nestlé may be entering markets already downward trending in breastfeeding duration.

By restricting the sample to just $t-1$, we don't consider trends and simply look at the threshold period (Table 8) as the counterfactual. Using the regional sample, (column 1) we find an unexpected result, as breastfeeding duration increase with import, but this specification doesn't allow us to control for unobservable heterogeneous variation. In column 2, when we run the cluster fixed effect specification, we see an expected but insignificant trend. Column 3 however, when including the full cluster sample with a cluster fixed effect, we find the expected negative trend of reduced breastfeeding after Nestle enter, and a slightly positive trend before it enters, all within interval at a 95% level (also see figure 1).

4.2.3 Robustness Checks

As mentioned several times before, endogenous market entry is the primary threat to identification. By accounting for FDI (net flows: percentage of country's GDP, World Bank) in table 9, we find results consistent with baseline regression (Table 2), but less significant. A significant decrease appears for the regional sample in the first two years, post-entry, when we include a cluster fixed effect using the cluster sample.

Next, we test whether the model holds with exclusion or inclusion various sample traits (Table 10). We include children still being breastfed, holding child age at survey constant, and the results don't change significantly (Column 1). When we don't control for the child age at survey, but exclude current breastfeed children (Column 2), and then impose the converse (including still breastfed children without controlling for child age at survey), we find a probable downward bias. Unconditionally examining breastfeeding reductions appears to downward our results (children born 4 years, post-entry, report a 17-month reduction compared to counterparts before). Therefore, controlling for the child's age at survey seems appropriate and justified.

Since Nestlé's entry may be simultaneous in several countries, and not all countries have leads and lags, we may have instances where all observations that are regressed in the same year. If this occurs, then the year fixed effect is meaningless for that time period, since no within variation exists. We drop the year fixed effect in Column 4, and although we lose some significance, the results hold at the 5% level. In Column 5 we include a country by birth year fixed effect as an alternative way to absorb all the time specific- and country-specific variation, but find no significance using it.

There is a greater density among respondents reporting breastfeeding their children for 1 year, one-and-a-half years and 2 years (Figure 2: Appendix 1), which might be a result of inaccurate recollection or a heuristic (easier to recall years than months), leading to an under or overestimation of the effect. We test these competing hypotheses by excluding all children breastfed for 12 months, 18 months and 24 months (Column 6.) and find the trend consistent with the baseline regression: a reduction of 5 and 6 months 3-4 years after Nestlé's entry, significant at a 1 percent level.

Overall, these results are consistent with the main findings in Table 2 for the cluster sample, confirming our suspicion that breastfeeding duration reductions are as result of Nestlé's operation in a country. Furthermore, using lags and leads with relevant controls, and plausibly controlling for market entry emboldens this conclusion.

5. Discussion

Given pre-trend data (Table 7), Nestlé appears to enter markets with downward breastfeeding trends. These findings are consistent with the literature that shows that there is a higher demand for breastfeeding substitutes in emerging economies where more women are entering the workforce. Whereas the previous literature highlights that working, educated women in urban areas are more likely to reduce breastfeeding duration and utilize infant formula, our results show quite the opposite. Given our contrarian findings on workforce participation and education status on breastfeeding changes, there may be other plausible explanations for this sample. Higher educated women may be more aware of the importance of breastfeeding, and those that work are likely more educated and have higher SES, all indicators of access to better health services and information. However, the results are for the less educated and non-working mothers, since the potential health consequences related to infant formula could lead to vicious cycles in low human capital development. There may also be a negative peer effect, an important breastfeeding behavior determinant, in the rural less developed areas that spreading from urban to rural areas through the channel of disinformation (Nestle) or misinformation (the public). Nestlé claim that they do not specifically try to get mothers to switch from breastfeeding to infant formula feeding. Regardless of whether this effect is intentional on Nestlé's behalf, our results indicate that Nestlé's entry in fact affect breastfeeding behavior stronger in some areas that previously was unknown.

Because of the importance of early cognitive and immune system development in an infant, (Table 3) the trend of early weaning (less than 6 months) from breastfeeding is even more alarming, considering the negative impacts to human capital development. Furthermore, those mothers most vulnerable, those without gainful employment or education, further, could exacerbate this trend reinforcing the vicious cycle and leading to early childhood mortality (second leading cause of child mortality under 5 years of age: WHO, 2009).

Our results show significant reductions in breastfeeding duration in the cluster sample, partial reductions in the regional sample, and no changes in the mother sample, and we suspect this can be partly explained by the limitation of comparing children born to the same mother. Birth order matters and comparing older child to younger children, by definition, seems flawed, and that is why we consider the regional and mother samples to provide spurious results. This is even more probable, given the fact that one mother's decision to change breastfeeding behavior is time dependent, but less so at a village level, since women having their firstborn after Nestlé entry may be more influenced by the infant formula industry, than a mother already with children.

5.1 Limitations

Besides the limitations mentioned some of the variables and proxies could be problematic. First, the DHS breastfeeding variable is overall breastfeeding duration and does not provide intensity level; therefore, although a dependent variable of mothers exclusively breastfeeding (without complementary feeding practices) would have been ideal in better capturing the true effect, it was not available in the DHS. Second, as mentioned several times before, even after controlling for FDI, we cannot intimately know the factors that go into Nestlé's business decisions about market entry. Third, our treatment variable is a dummy measuring absolute not relative impact, so we don't have import intensity or market sector specifics, so we don't know true exposure rates. In addition, we do not have information on other formula companies, that means there might already be access to infant formula in the country. This is likely to give more noisy signals.

Lastly, there have been done large efforts in order to promote breastfeeding in the world since the controversies in the 1970s. All our data is from after the WHO act was created in 1981. As mentioned, the WHO act is not legally binding unless it is has been incorporated into a country's national law. Some countries in the sample incorporated the Act into law around Nestlé's market penetration, like Guatemala (enacted 1983; penetration 1985) and Colombia (enacted 1992; penetration 1993). National regulation can make a significant difference in formula sales, given that it is sufficiently enforced (Mason, 2013). In India, the Infant Milk Substitutes Act (IMSA) of 1991 strictly controls advertising, and exclusively breastfeeding for 4-6 month of age is almost three times higher as it is in the Philippines, where they do not have this type of control (Brady, 2012).

5.2 Conclusion

Analyzing 11 tropical countries, using Nestlé's annual reports and breastfeeding data from the DHS, we find strong and negative impacts on breastfeeding reduction from infant formula advertising. This is clearly concerning given the consensus in the medical community about breastfeeding -- it is the best investment in child health and leads to reductions in child mortality -- and the risks associated with infant formula. Our findings suggest that Nestlé drives down breastfeeding duration after market entry, under certain conditions.

Thus, implications for further research to uncover the forces at play include understanding the causes of (1) reduction of breastfeeding in rural areas and (2) reductions below the essential 6 month-mark. Even more important is to measure negative child health impacts resulting from these findings. Research like this not only is justified from a human perspective, but also an economic one, and so transnational laws like WHO act are important, so are national ones that can be enforced. The accuracy and effect of any law is likely to increase if lawmakers can base their work on a picture of reality that is as accurate as possible. Finally, it will be in the best interest of Nestlé to further investigate these topics to enhance their position as a company that care about Corporate Social Responsibility (CSR). CSR is not only important from an ethical standpoint, and failing to act or recognize the implications of CSR can have devastating economic effects in the form of boycotts or sanctions, or both.

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TABLES AND FIGURES:

List of Counties:

Country	**Year Imports Begin**
Bangladesh	1993
Cambodia	1998
Colombia	1993
Egypt	1988
Ghana	1993
Guatemala	198
Jordan	1999
Morocco	1992
Pakistan	1990
Peru	1985
Vietnam	1997

Table 1: Summary Statistics

VARIABLES	N	Mean	SD	Min	Max
MOTHER VARIABLES					
Survey Year	77,748	1995	5.082	1986	2007
Rural	77,748	0.615	0.487	0	1
No Education	77,747	0.394	0.489	0	1
Primary Education	77,747	0.305	0.460	0	1
Higher Education	77,747	0.0518	0.222	0	1
Illiterate	20,932	0.202	0.401	0	1
Total Number of Children	77,748	3.799	2.473	1	18
Age when Child is Born	77,748	26.74	6.581	10	50
CHILD VARIABLES					
Birth Year	77,748	1993	4.999	1981	2004
Months Breastfed	77,748	13.74	10.07	0	59
Rural	47,787	14.929	10.327	0	59
Urban	29,961	11.843	9.330	0	59
No Education	30,611	15.165	10.431	0	59
Higher Education	4,031	10.514	8.342	0	55
Never Breastfed	77,748	0.0781	0.268	0	1
Breastfed under 6 Months	77,748	0.291	0.454	0	1
Still Breastfed during Survey	77,748	0.354	0.478	0	1
Dies Within a Year after Birth	77,748	0.0554	0.229	0	1
Dies Within 5 Year after Birth	77,748	0.0653	0.247	0	1

Table 2 - Baseline

VARIABLES	(1) **Months Breastfed** Regional Sample	(2) **Months Breastfed** Regional Sample	(3) **Months Breastfed** Cluster Sample	(4) **Months Breastfed** Mother Sample
Import Year	-0.612	-1.013**	-0.602	2.109
	(0.651)	(0.434)	(0.429)	(1.570)
Import Year + 1	-0.468	-1.398***	-2.301**	0.314
	(0.961)	(0.467)	(1.060)	(3.135)
Import Year + 2	0.525	-2.445***	-3.719**	-0.901
	(1.269)	(0.620)	(1.825)	(4.430)
Import Year + 3	-1.238	-4.892***	-6.240***	1.063
	(1.220)	(0.781)	(1.769)	(8.527)
Import Year + 4	-1.780	-5.952***	-6.835***	
	(1.318)	(1.146)	(2.059)	
Import Year + 5	-2.185	-6.320***		
	(1.821)	(1.653)		
Constant	4.655	-5.045	-15.78	-15.33
	(3.836)	(20.77)	(20.73)	(9.675)
Observations	50,195	50,195	30,963	11,811
R-squared	0.234	0.374	0.347	0.855
Region FE	x			
Cluster FE		x	x	
Mother FE				x

*p<0.1 , ** p<0.05, *** p<0.01

Notes: All regressions have following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 3 - Breastfed Under 6 Months

VARIABLES	(1) **Breastfed Under 6 Months** Regional Sample	(2) **Breastfed Under 6 Months** Regional Sample	(3) **Breastfed Under 6 Months** Cluster Sample	(4) **Breastfed Under 6 Months** Mother Sample
Import Year	0.0213	0.0163	0.00745	-0.0592
	(0.0267)	(0.0190)	(0.0201)	(0.0950)
Import Year + 1	0.0313	0.0367	0.0833*	0.0245
	(0.0342)	(0.0241)	(0.0428)	(0.193)
Import Year + 2	0.0148	0.0640**	0.131*	0.0233
	(0.0449)	(0.0319)	(0.0712)	(0.269)
Import Year + 3	0.0652	0.131***	0.178***	-0.148
	(0.0466)	(0.0350)	(0.0638)	(0.409)
Import Year + 4	0.0651	0.145***	0.161**	
	(0.0561)	(0.0393)	(0.0737)	
Import Year + 5	0.103	0.153***		
	(0.0768)	(0.0579)		
Constant	0.769***	1.122	1.590*	1.572***
	(0.158)	(0.917)	(0.933)	(0.482)
Observations	50,195	50,195	30,963	11,811
R-squared	0.176	0.342	0.316	0.778
Region FE	x			
Cluster FE		x	x	
Mother FE				x

Table 4: Rural vs. Urban

VARIABLES	(1) **Months Breastfed** Rural Cluster Sample	(2) **Months Breastfed** Urban Cluster Sample	(3) **Months Breastfed** Rural Mom Sample	(4) **Months Breastfed** Urban Mom Sample
Import Year	-1.116**	-0.447	0.916	2.610
	(0.480)	(0.677)	(1.663)	(3.551)
Import Year + 1	-2.755***	-1.356	-1.119	0.577
	(0.991)	(1.942)	(3.542)	(6.137)
Import Year + 2	-5.361***	-0.381	-2.964	3.254
	(1.665)	(3.103)	(5.625)	(7.241)
Import Year + 3	-7.209***	-2.770	-2.057	1.323
	(1.530)	(2.725)	(11.72)	(21.72)
Import Year + 4	-7.583***	-2.590		
	(1.782)	(2.670)		
Constant	-28.38	6.975	-12.80	-14.91
	(23.70)	(20.66)	(11.71)	(19.27)
Observations	18,969	11,994	7,461	4,350
R-squared	0.338	0.333	0.867	0.845
Cluster FE	x	x		
Mother FE			x	x

*p<0.1 , ** p<0.05, *** p<0.01

Notes: All regressions have following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 5: Education Level

	(1)	(2)	(3)	(4)
	Months Breastfed	**Months Breastfed**	**Months Breastfed**	**Months Breastfed**
	No Education	Primary Education	Secondary Education	High Education
VARIABLES				
Import Year	-1.158	-0.879	0.867	3.278
	(0.727)	(1.070)	(1.209)	(8.472)
Import Year + 1	-2.305***	-2.852	2.931	21.13**
	(0.845)	(1.841)	(3.876)	(7.951)
Import Year + 2	-3.562***	-6.608***	0.0763	21.61*
	(1.283)	(2.420)	(4.827)	(11.14)
Import Year + 3	-3.350***	-11.09***	-4.335	-13.21
	(1.212)	(2.788)	(4.778)	(14.77)
Import Year + 4	-5.911***	-8.426**	-2.366	
	(1.800)	(3.933)	(6.766)	
Constant	-48.90	-29.65	9.204	-8.456
	(41.34)	(27.25)	(18.96)	(13.43)
Observations	12,052	9,604	7,598	1,709
R-squared	0.396	0.475	0.507	0.653
Cluster FE	x	x	x	x

*p<0.1 , ** p<0.05, *** p<0.01

Notes: All regressions are with the cluster sample, and have the following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 6 - Work Status

	(1)	(2)	(3)
	Months Breastfed	**Months Breastfed**	**Months Breastfed**
	Works All Year	Works Seasonally	Works Rarely
VARIABLES			
Import Year	-0.712	-1.364***	-1.388***
	(0.432)	(0.364)	(0.365)
Import Year + 1	-0.801	-1.432***	-1.421***
	(0.589)	(0.487)	(0.496)
Import Year + 2	-0.545	-1.565***	-1.450**
	(0.793)	(0.567)	(0.584)
Import Year + 3	-3.519***	-3.866***	-4.172***
	(1.087)	(0.760)	(0.780)
Import Year + 4	-4.089**	-4.968***	-6.765***
	(1.584)	(1.517)	(1.446)
Constant	-42.82	-72.47	-29.86
	(49.88)	(46.80)	(51.91)
Observations	39,882	36,408	31,448
R-squared	0.432	0.378	0.359
Cluster FE	x	x	x
Mother FE			

*p<0.1 , ** p<0.05, *** p<0.01

Notes: All regressions are with the cluster sample, and have the following controls; Birth Order by Gender FE , Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 7 - Different Leads and Lags

VARIABLES	(1) **Months Breastfed** Cluster Sample	(2) **Months Breastfed** Cluster Sample	(3) **Months Breastfed** Cluster Sample	(4) **Months Breastfed** Cluster Sample
Import Year - 4	-1.720			
	(2.960)			
Import Year - 3	-3.933	-0.492		
	(5.849)	(1.283)		
Import Year - 2	-6.523	-1.363	-0.668**	
	(8.755)	(1.768)	(0.336)	
Import Year - 1	-9.884	-3.003	-2.002***	-1.192*
	(11.74)	(2.445)	(0.740)	(0.641)
Import Year	-13.04	-4.441	-3.147***	-2.088**
	(14.50)	(3.208)	(1.101)	(0.931)
Import Year + 1	-17.52	-7.196	-5.587***	-4.386***
	(17.31)	(4.343)	(1.722)	(1.569)
Import Year + 2	-21.45	-9.406	-7.461***	-5.920**
	(20.16)	(5.717)	(2.444)	(2.296)
Import Year + 3	-26.78	-13.01**	-10.86***	-8.689***
	(23.08)	(6.206)	(2.486)	(2.254)
Import Year + 4	-30.68	-15.20**	-12.75***	-10.48***
	(26.10)	(6.985)	(3.182)	(3.011)
Constant	21.49	-2.779	-6.730	-10.59
	(20.56)	(22.62)	(21.11)	(20.99)
Observations	30,963	30,963	30,963	30,963
R-squared	0.347	0.347	0.347	0.347
Cluster FE	x	x	x	x
Mother FE				

*p<0.1 , ** p<0.05, *** p<0.01

Notes: All regressions have following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 8 – Import Year-1 as Counterfactual

VARIABLES	(1) **Months Breastfed** Regional Sample	(2) **Months Breastfed** Regional Sample	(3) **Months Breastfed** Cluster Sample	(4) **Months Breastfed** Mother Sample
Import Year - 5	-7.155***	-1.237		
	(2.597)	(10.17)		
Import Year - 4	-5.378**	0.0811	0.751	-2.853
	(2.101)	(7.633)	(0.611)	(3.288)
Import Year - 3	-3.245**	0.115	1.009***	-0.164
	(1.345)	(5.106)	(0.363)	(2.565)
Import Year - 2	-1.494*	0.246	0.889*	-1.073
	(0.811)	(2.567)	(0.455)	(1.317)
Import Year	1.250	-0.792	-0.688	3.018*
	(0.812)	(2.446)	(0.486)	(1.722)
Import Year + 1	3.236**	-0.913	-2.692**	1.959
	(1.625)	(5.010)	(1.277)	(3.407)
Import Year + 2	6.139***	-1.945	-4.151*	2.621
	(2.291)	(7.554)	(2.179)	(5.007)
Import Year + 3	6.118**	-4.381	-7.008***	3.583
	(2.644)	(10.09)	(2.054)	(9.386)
Import Year + 4	7.196**	-5.530	-8.441***	
	(3.066)	(12.56)	(2.400)	
Import Year + 5	8.566**	-5.888		
	(3.318)	(15.07)		
Constant	-24.10***	-5.983	-13.37	-17.88*
	(8.987)	(11.46)	(21.10)	(10.07)
Observations	50,195	50,195	30,963	11,811
R-squared	0.234	0.374	0.347	0.855
Region FE	x			
Cluster FE		x	x	
Mother FE				x

*p<0.1 , ** p<0.05, *** p<0.01

Notes: Import year – 1 is the omitted category. All regressions have following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 9 - FDI control

	(1)	(2)	(3)	(4)
	Months Breastfed	**Months Breastfed**	**Months Breastfed**	**Months Breastfed**
	Regional Sample	Regional Sample	Cluster Sample	Mother Sample
VARIABLES				
Import Year	-0.800	-1.480**	-1.453*	4.989
	(0.639)	(0.593)	(0.733)	(3.272)
Import Year + 1	-0.619	-1.895***	-1.915	4.183
	(1.126)	(0.530)	(1.176)	(4.350)
Import Year + 2	0.128	-2.155***	-1.367	5.203
	(1.341)	(0.773)	(1.652)	(4.936)
Import Year + 3	-0.874	-2.370	1.858	17.48**
	(1.361)	(1.427)	(2.141)	(7.233)
Import Year + 4	-0.421	0.0712	2.359	
	(1.695)	(1.862)	(2.532)	
Import Year + 5	-2.836	0.0471		
	(2.072)	(2.396)		
Constant	-0.912	-25.66	-70.87***	-69.97**
	(5.366)	(20.00)	(21.88)	(28.33)
Observations	45,937	45,937	28,215	10,430
R-squared	0.243	0.394	0.366	0.862
Region FE	x			
Cluster FE		x	x	
Mother FE				x

*p<0.1 , ** p<0.05, *** p<0.01

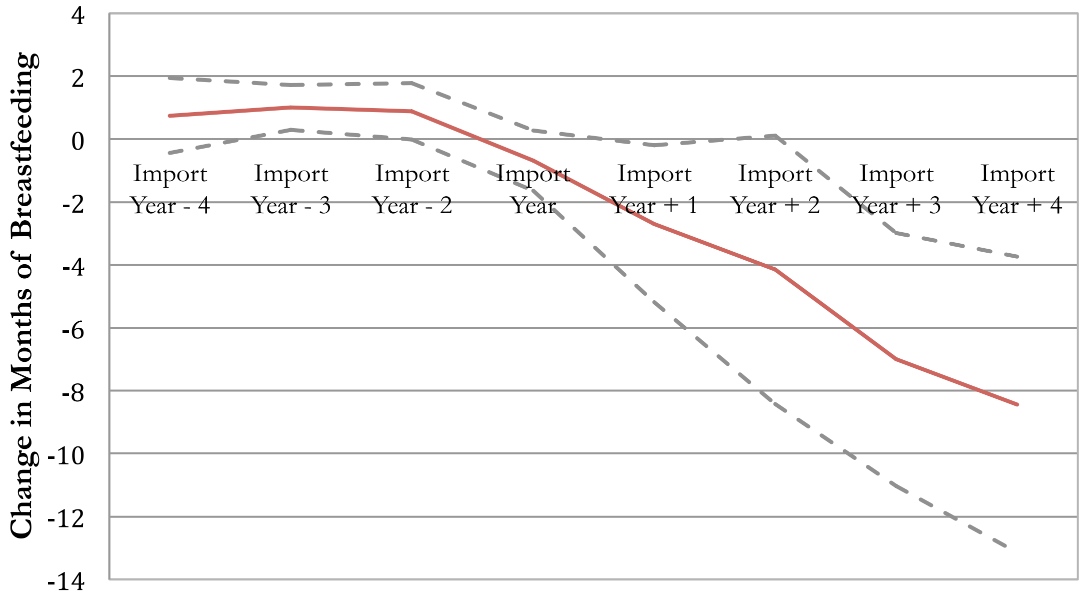
Notes: All regressions have following controls; Birth Order by Gender FE, Age at Survey, Year FE, Country by Birth Month FE. Children still being breastfed at survey are dropped

Table 10 - Robustness Checks

VARIABLES	(1) Months Breastfed	(2) Months Breastfed	(3) Months Breastfed	(4) Months Breastfed	(5) Months Breastfed	(6) Months Breastfed
Import Year	-0.410*	-2.036***	-3.706***	-0.261	0.139	0.325
	(0.217)	(0.402)	(0.248)	(0.381)	(0.306)	(0.456)
Import Year + 1	-1.185***	-4.985***	-7.012***	-0.794	-0.123	-1.766
	(0.376)	(0.845)	(0.580)	(0.929)	(0.689)	(1.187)
Import Year + 2	-2.834***	-6.780***	-13.06***	-0.994	-0.178	-2.677
	(0.551)	(1.222)	(1.014)	(1.702)	(1.014)	(1.938)
Import Year + 3	-6.443***	-9.964***	-16.63***	-3.950	-1.257	-5.365***
	(0.609)	(1.123)	(1.205)	(2.387)	(1.322)	(1.967)
Import Year + 4	-4.240***	-13.85***	-17.54***	-4.757**	-2.114	-6.645***
	(0.738)	(1.160)	(1.221)	(2.357)	(2.142)	(2.261)
Constant	19.60***	-1.861	16.63***	-0.816	7.098	-10.44
	(1.441)	(2.547)	(2.323)	(1.257)	(10.92)	(17.69)
Observations	51,038	30,963	51,038	30,963	30,963	20,336
R-squared	0.375	0.194	0.282	0.340	0.350	0.390
Controls:						
Year FE	x	x	x			x
Country by Birth Month FE	x	x	x	x		x
Country by Birth Year FE					x	
Gender by Birth Order FE	x	x	x	x	x	x
Age at Survey FE	x			x	x	x
Still Breastfed Included	x		x			
12, 18, 24 months Excluded						x
Cluster FE	x	x	x	x	x	x

*p<0.1 , ** p<0.05, *** p<0.01

Figure 1



Notes: Figure one is based on Table 8, column 3, the red line is the coefficient and the grey dashed lines are the upper and lower confidence interval at a 95% level.

APPENDIX 1

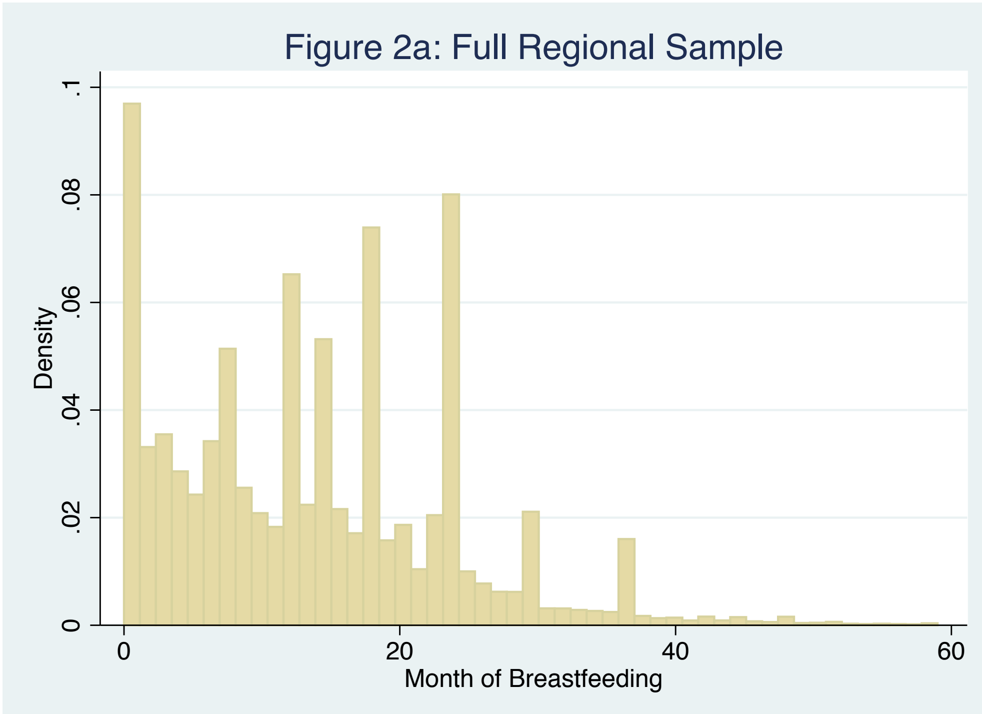


Figure 2a: Full Regional Sample
Density
0
.02
.04
.06
.08
.1
0
20
40
60
Month of Breastfeeding

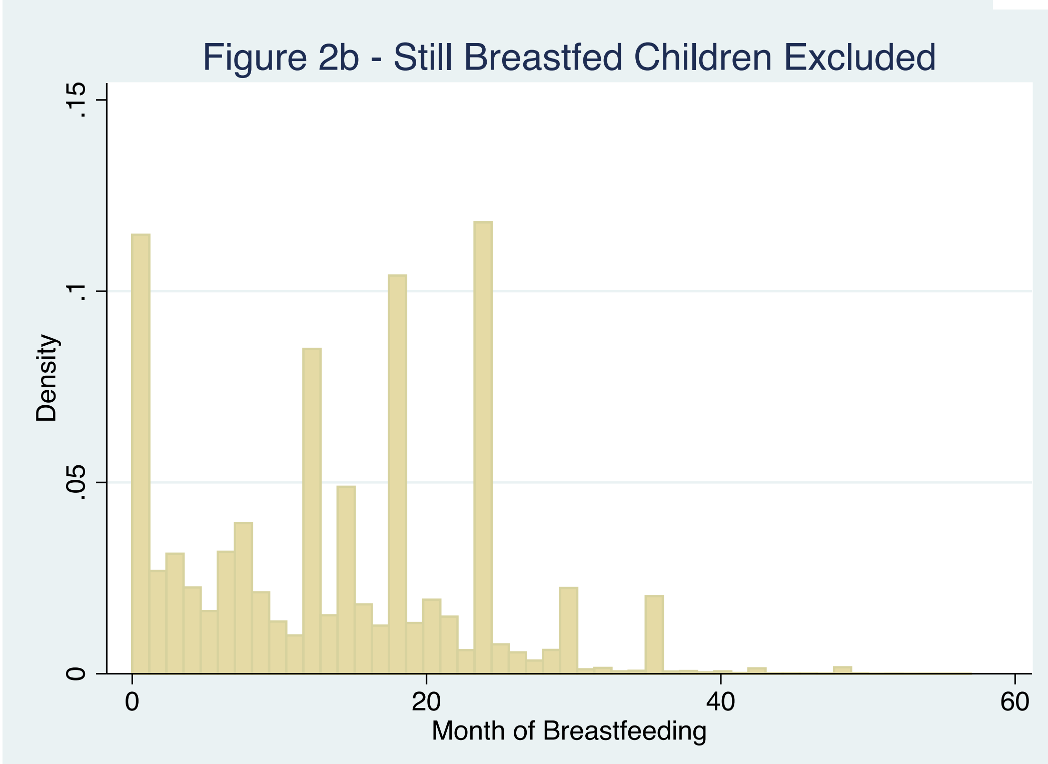
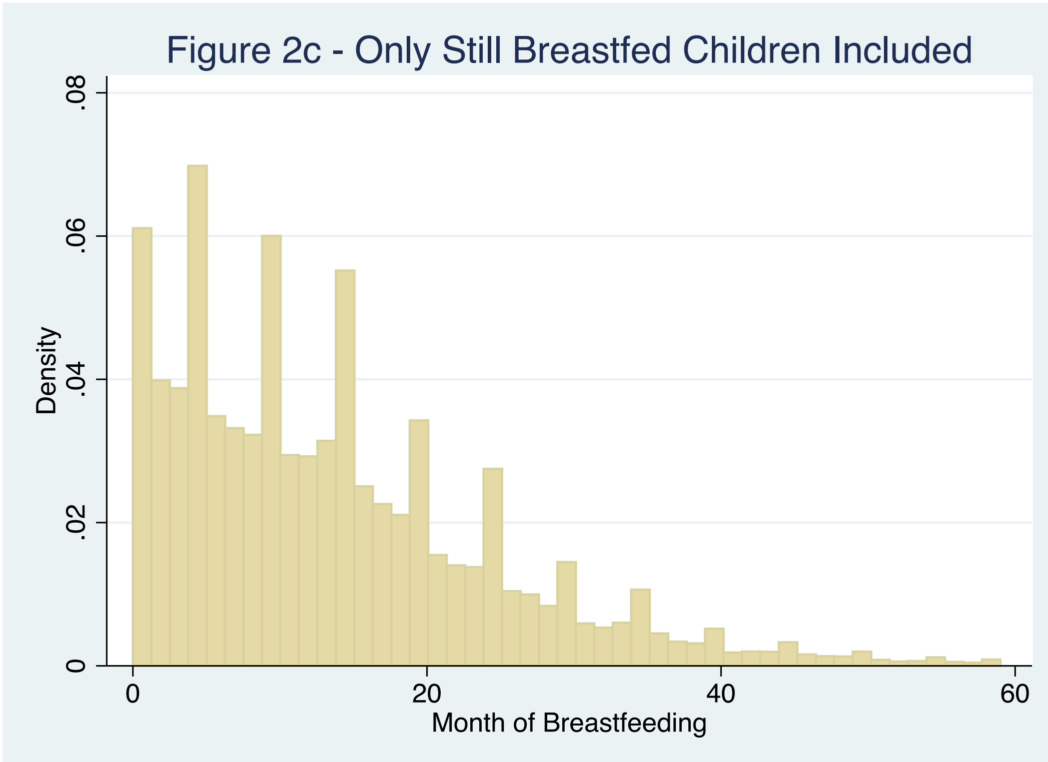


Figure 2b - Still Breastfed Children Excluded
Density
0
.05
.1
.15
0
20
40
60
Month of Breastfeeding



National Legislative Status of the WHO act

Country	Legislative Status	Year
Bangladesh	Many Provisions Law	1984
Cambodia	Many Provisions Law	2007
Colombia	Many Provisions Law	1992
Egypt	Many Provisions Law	.
Ghana	Full into Law	2000
Guatemala	Full into Law	1983
Jordan	Many Provisions Law	.
Morocco	Measure Drafted	.
Pakistan	Full into Law	2002
Peru	Full into Law	1982
Vietnam	Many Provisions Law	2006

Source: WHO, 2011