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Article

Integrating motherhood and employment: A 22-year analysis investigating impacts of US workplace breastfeeding policy

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ABSTRACT

The United States has one of the lowest exclusive breastfeeding rates among high-income countries. Most experts agree that there is a lack of mother-friendly workplace policies compared to other countries. Since 1995, 25 states have implemented workplace breastfeeding legislation allowing mothers to express and store breast milk in the workplace. There is heterogeneity in policy enforceability where 17 states have weak enforceability while eight states have strict enforceability and require employers to offer provisions to breastfeed at the workplace. Using difference-in-differences methods, we examine the impact of this policy on state-level breastfeeding rates and assess how that impact differs with policy enforceability. We use data from the Centers for Disease Control on breastfeeding, supplementing with socio-economic data from the Panel Study of Income Dynamics, Current Population Survey, the US Census Bureau and several other datasets over 22 years from 1990 to 2011. We find that states with legislation experienced a 2.3-percentage point increase in breastfeeding rates compared to states without legislation while states with weak enforceability experienced a 3.1-percentage point increase compared to states without legislation. We also find that policies do not start to have an impact until 1–2 years after they were signed into law. Considering the recent assault on breastfeeding from the current administration, our study is a timely and important contribution that strengthens the evidence base for the health benefits of workplace breastfeeding policies.

2. Introduction

The United States (US) has one of the lowest breastfeeding rates worldwide. The national average 6-months exclusive breastfeeding rate is 25%, lower than for example Canada (26%) (Statistics Canada, 2013), Brazil (41%) (UNICEF, 2013a), and Ghana (46%) (UNICEF, 2013b). In addition, the US has one of the highest percentages of mothers with infants in the workforce at 57%, and poor workplace support for breastfeeding mothers such as lactation programs or maternity leave (Save the Children, 2012; UNICEF, 2015; United States Department of Labor, 2013). Breastfeeding has well-documented health benefits to mothers and children, including protection from several childhood infections (Fletcher, 2011; Singhal & Lanigan, 2007; Victora & Barros, 2000; Victora et al., 2015; WHO, 2000). Additionally, employers supporting breastfeeding through policies benefit through reduced maternity leave and absenteeism, higher productivity, and lower healthcare costs (Flood, 2009; Rollins et al., 2016). Failure to breastfeed is estimated to cost $302 billion globally per year while in the US, $13 billion in medical costs could be saved if breastfeeding rates increased to 90% (Bartick & Reinhold, 2010; Rollins et al., 2016). Breastfeeding is not only an investment in the health of populations but also in the prosperity of economies (Hansen, 2016).

Being employed has been identified as the most significant barrier to breastfeeding (Office of the Surgeon General (US); Centers for Disease Control and Prevention (US); Office on Women's Health (US), 2011). Women experience social stigma and practical difficulties when

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expressing milk in the workplace due to lack of breastfeeding facilities and inadequate maternal leave policies (Office of the Surgeon General (US); Centers for Disease Control and Prevention (US); Office on Women's Health (US)., 2011). Therefore, most mothers cease to breastfeed when they return to work after giving birth (Office of the Surgeon General (US); Centers for Disease Control and Prevention (US); Office on Women's Health (US), 2011). A promising approach to support breastfeeding mothers at the workplace is legislation: so-called 'pumping policies' with provisions to provide facilities for expressing and storing breast milk in the workplace helping mothers reconcile financial and family responsibilities, reap the dual economic and health benefits of breastfeeding and employment while employers benefit from retaining women at work. There is evidence that mothers make decisions related to breastfeeding based on their workplace situation, such as working hours (Roe et al., 1999). Since 1995, 25 states have implemented workplace breastfeeding legislation with differing enforceability, either encouraging or requiring companies to provide facilities that allow mothers to express breast milk in privacy and store the milk to feed the infant in the evening.

A few studies have shown associations between workplace breastfeeding facilities, legislated breastfeeding breaks and breastfeeding rates (Dozier & McKee, 2011; Hawkins, Stern, & Gillman, 2013; Heymann, Raub, & Earle, 2013; Kogan et al., 2008; Smith-Gagen et al., 2014). Unfortunately, these studies were descriptive, limited to a few states, or failed to control for important confounding factors including mothers' income, hours worked, and determinants of maternal employment (Gatrell, 2007; Scott et al., 2006). One study covered only a short data period and failed to analyze sustained impacts and delayed effects of the policy. A systematic review by Abdulwadud et al. (2006) called for causal inference on this question (Abdulwadud & Simpson, 2006).

The objective of our study is to evaluate the 22-year impact of workplace breastfeeding policies on breastfeeding rates in the US, and whether and how the impact of such policies varies with enforceability. We employ difference-in-differences and data on breastfeeding from the Centers for Disease Control (CDC) for 1990–2011, supplemented with data from the Panel Study of Income Dynamics.

Our study is the first to provide robust long-term evidence on the causal impact of breastfeeding policies, and to evaluate the difference in impact according to legislation enforceability. We improve over existing studies both methodologically and in terms of scope of analyses. First, we assess how the impact varies according to legal enforceability, which may influence the efficacy of the policy. We also assess how long the policy took to have an effect using a longer study period, where previous studies were limited to much shorter periods.

Finally, we contribute to the economics literature on breastfeeding, which has shown that mothers' decision to breastfeed is influenced by their workplace environment, with employment being one of the greatest barriers to breastfeeding. We additionally contribute to the broader literature on family-friendly policies, where there is evidence that policies to support mothers are important in mitigating discriminatory practices that women may face in employment (Kleven, Landais, & Søgaard, 2018). Such policies are key as women are more likely to face career interruptions due to childbirth compared to men. The responsibility of childrearing still largely falls on mothers due to the unequal distribution of household responsibilities within couples (Angelov, Johansson, & Lindahl, 2016; Baum, 2002; Napari, 2010). As a consequence, having a child affects mother's health and labor market outcomes more negatively compared to fathers. The literature focuses on two types of family-friendly policies: the first encourages parents to be absent from work (e.g. parental leave); the second type encourages and supports parents to go into work after childbirth (e.g. workplace breastfeeding policies). While leave policies are important, they tend to be largely reserved for mothers rather than fathers, generating an additional imbalance within households in regards to childcare responsibilities. The second type, however can enable a better work environment and promote equality within the workplace and households as mothers are incentivized to go into work after child birth—similar to men. Therefore, workplace breastfeeding policies can play a significant role in alleviating the conflict between childrearing and employment and create better opportunities for women to reconcile work with motherhood. At a time where there are worrying sentiments against breastfeeding in the US, our study informs policy makers with crucial evidence that shows the value of policies that promote breastfeeding and encourage mothers to return to work after childbirth.

2.1. Policy background

The Family and Medical Leave Act (FMLA) of 1993 allows mothers up to 12 weeks unpaid leave and job-protection (US Department of Labor, 1993), however, there are variations in leave policies across states and industries with those in lower paid jobs being disadvantaged and having to return to work earlier (Desilver, 2017; National Conference of State Legislatures, 2017). This contributes to socioeconomic inequities in breastfeeding rates. Asian mothers have the highest rates at 30.1% and African American mothers have the lowest rates at 17.2% (National Immunization Survey, Centers for Disease Control and Prevention, & Department of Health and Human Services, 2014). Mothers who are college graduates also have higher exclusive breastfeeding rates at 32.8% compared to mothers who are high school graduates at 17.8% (National Immunization Survey et al., 2014). State-specific workplace breastfeeding policies have been enacted in 25 out of 50 US states and Washington DC between 1995 and 2011 with the objective of encouraging all employed women to breastfeed (Table 1).

Information on the nature and date of enactment of the policies is collated from the National Conference of State Legislatures (National Conference of State Legislatures, 2016) and corroborated by reviewing each state's workplace breastfeeding statutes. Additionally, there is heterogeneity in the policies across states (Fig. 1).

Policies differ in provisions for facilities and break time, and in their

Table 1
US states with and without workplace breastfeeding legislation, years 1990–2011 (Del Bono and Pronzato, 2012; Gielen, Faden, O'Campo et al., 1991; Hawkins, Griffiths, Dezateux et al., 2007; Office of the Surgeon General (US) et al., 2011; Thulier and Mercer, 2009; Wing, Simon and Bello-Gomez, 2018).

States without legislation	States with legislation (year signed into law)
Alabama	Arkansas (2009)
Alaska	California (1998)
Arizona	Colorado (2008)
Delaware	Connecticut (2001)
Florida	District of Columbia (2007)
Idaho	Georgia (1999)
Iowa	Hawaii (1999)
Kansas	Illinois (2001)
Kentucky	Indiana (2008)
Louisiana	Maine (2009)
Maryland	Minnesota (1998)
Massachusetts	Mississippi (2006)
Michigan	Montana (2007)
Missouri	New Mexico (2007)
Nebraska	New York (2007)
Nevada	North Dakota (2009)
New Hampshire	Oklahoma (2006)
New Jersey	Oregon (2007)
North Carolina	Rhode Island (2003)
Ohio	Tennessee (1999)
Pennsylvania	Texas (1995)
South Carolina	Vermont (2008)
South Dakota	Virginia (2002)
Utah	Washington (2001)
West Virginia	Wyoming (2003)
Wisconsin	

Note: States with legislation require or encourage employers to provide breastfeeding facilities and break time. Break time is unpaid in all states with legislation except for Indiana. For further details, see Appendix A. Vermont is not included in analysis due to insufficient observations.

levels of enforceability; 18 states require breaks and 21 require provision of hygienic facilities including a private room, a fridge to store milk, and a pump; 17 states have strict enforceability where policies require employers to provide both facilities and break time, and eight states have weak enforceability where policies merely encourage firms to provide facilities and/or break time. In 23 states the policy applies to all employers, and in two states firms with less than 25 employees are not required to comply. Legislation was first enacted in Texas (1995), and most recently in Maine in 2009. Over our study period, only California has changed its policy from 'encouraging employers' to 'requiring employers' however has 'required employers' for ten years during our study period, and no states have repealed legislation after enactment (further details in Appendix A).

3. Methods

3.1. Study sample

We build a panel dataset at the state and year level using several datasets for the years 1990–2011: the Ross Mother's Survey (RMS) (US Ross Products Division, 2000); the National Immunization Survey (NIS) (CDC, 2013); the Panel Study of Income Dynamics (PSID) (PSID, 2020); the Childhood and Adoption History Supplement from the PSID (CAH) (PSID, 2020); the Current Population Survey (CPS) (Center for Economic and Policy Research, 2019); Centers for Medicare and Medicaid Services (CMS) (Centers for Medicare and Medicaid Services, 2017), US Census Bureau (US Census Bureau, 2018), Bureau of Labor Statistics (US Bureau of Labour Statistics, 2016), US Center for American Women and Politics (Center for American Women and Politics, 2019) and National Conference of State Legislatures (NCSL, 2020).

Our outcome variable - breastfeeding rates-is measured at state and year level using the RMS and NIS data. It measures the proportion of mothers in a state and year who have ever breastfed from time of child birth until 6 months postpartum as a proportion of all mothers with an infant in the year they gave birth. Therefore, our measure does not include any child ever born to the mother but only infants born in the respective year the outcome is measured. It includes both mothers who breastfeed exclusively, and those who supplement breastmilk with other infant food. While there are other measures of breastfeeding in the RMS and NIS such as breastfeeding at 3 months and exclusive breastfeeding, the 'ever breastfed at 6 months' measure is appropriate for employed mothers who find it more challenging to breastfeed exclusively because they are separated from their infants over the day. There is evidence of the benefits of partial breastfeeding in comparison to formula feeding (Betrán et al., 2001; León-Cava et al., 2002; Sankar et al., 2015).

The CDC and the US Department of Health and Human Services use RMS and NIS to estimate national statistics on breastfeeding (Office of the Surgeon General (US); Centers for Disease Control and Prevention (US); Office on Women's Health (US)., 2011). The measure is consistently collected yearly in both surveys, in the years pre- and post-legislation enactment for all states. This is crucial for our quasi-experimental methodology. It also allows us to assess how long the policy took to have an effect, whereas previous studies were limited due to shorter study periods (Hawkins et al., 2013). For example, Hawkins et al. (2013) analyzed the impact of workplace policies on breastfeeding rates but used a much smaller sample of seven states over eight years, thus introducing potential sample selection bias (Hawkins et al., 2013).

We merge these data with covariates at state and year level from the PSID and other sources of state-level data to control for a broad range of time-variant confounding factors shown to be important predictors of breastfeeding. (Chen, Wu, & Chie, 2006; Gatrell, 2007; Scott et al., 2006). The PSID started in 1968, recruiting a nationally representative sample of 4800 households and has followed individuals and their spouses, children and cohabiters overtime. PSID collects socio-demographic, economic, and health data on households and individuals (Hill, 1991). The CAH is a supplemental to the PSID with data on child's birth year and state. The rich information contained in the PSID makes it one of the most extensively analyzed datasets in social science research (Hill, 1991).

We use the PSID to generate state-level covariates recorded for employed mothers with infants as well as the CPS for employed women in a state and year to generate a panel data set on state- and year-level. We aggregate mother-child pairs on state-and-year-level giving a complete set of 1122 observations of 50 states and Washington DC from 1990 to 2011 that we merged with our outcome variable. This is the maximum sample size to estimate an effect for all states over our time period. When generating state-level averages for covariates, we exclude women who have no children, are not employed at the time of giving birth, or are over 65 years of age at the time the data was collected. Therefore, we only include the targeted population of the workplace policy in our analyses, employed mothers with infants and employed women. This cleaner research design is a further improvement over Hawkins et al. (2013). We also include additional state-level covariates not found in the PSID or the CPS that have been collected on the

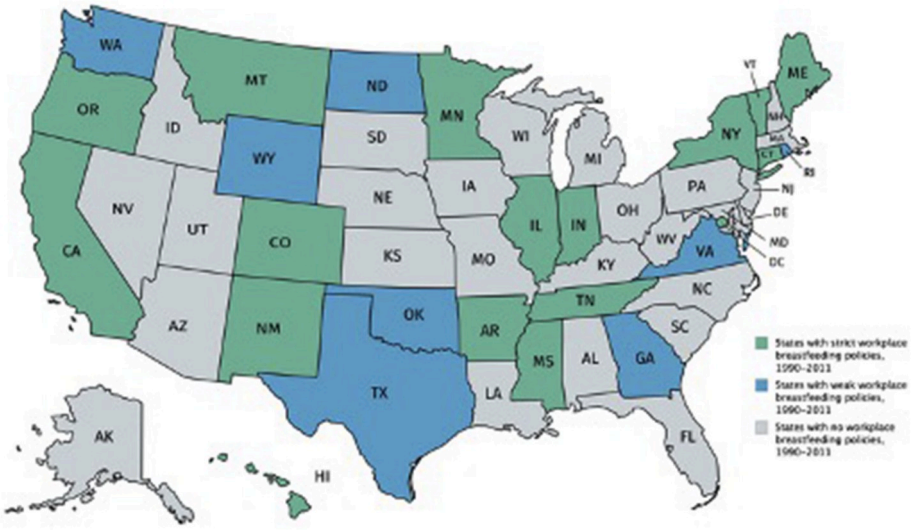

Fig. 1. US map of states with strict, weak, and no workplace breastfeeding policies, implemented 1990–2011.
Note: Strict enforceability refers to states that require both facilities and break time while weak enforceability refers to states that encourage facilities and/or break time. Vermont is not included in analysis due to insufficient observations.

state-level from the CMS, US Census Bureau, Bureau of Labor Statistics, US Center for American Women and Politics, and National Conference of State Legislatures (see Appendix B, Table B1). From the PSID, we include the following covariates: age, education, job hours per week on main job, and job type (i.e. white-collar or blue-collar). Variables included from the CPS include: number of children in household under 18 years of age, marital status, and race/ethnicity. We also use additional data from the US Census Bureau and the Bureau of Labor Statistics, namely median household income and unemployment rate (US Bureau of Labour Statistics, 2016; US Census Bureau, 2018). These variables capture the economic situation of mothers. We include state health expenditures per capita as a measure of healthcare spending and health status from the Centers for Medicare and Medicaid Services (Centers for Medicare and Medicaid Services, 2017). Finally, to control for state-related ideology and factors that can influence the passage of a mother-friendly policy, we control for state party affiliation from the National Conference of State Legislatures (NCSL, 2020) and percentage of women in state legislature from the US Center of American Women and Politics (Center for American Women and Politics, 2019).

We also include state fixed effects to control for potential state-specific confounders and year dummies to control for unobserved factors influencing all states in the same way in a year. With a rich set of breastfeeding and employment determinants, we substantially improve upon previous studies by Kogan et al. (2008), Dozier and McKee (2011), and Smith-Gagen et al. (2014), which used much simpler specifications (Dozier & McKee, 2011; Kogan et al., 2008; Smith-Gagen et al., 2014). See Appendix B for further information on data sources and covariance balance tests of all variables.

3.2. Statistical analyses

We investigate the impact of workplace breastfeeding legislation on breastfeeding rates using differences-in-differences methodology (DID), which is widely used to measure the impact of policy changes. DID measures the variation in breastfeeding rates attributable to policy enactment by comparing differences in rates between states without the policy (control states) and states with the policy (treatment states) before the policy, with differences after the policy has been implemented. This 'nets' the effect from biases resulting from permanent differences between states with and without the policy. DID methodology is applicable since: (1) the state laws impact a readily identifiable group—mothers with infants and (2) the state and year variation in enactment of the policies can be exploited to separate states with legislation from states without legislation through DID.

There are 25 *treatment states* where the policy was implemented sometime over the observation period, and 26 *control states* where the policy has never been implemented (Table 1). Our explanatory variable of interest, the DID policy variable, identifies the impact of the policy after its initial enactment; it assumes value 1 for each time period after the treatment (legislation enacted) started and for states where legislation is in place.

DID requires three groups of variables to identify the policy impact on an outcome of interest: the outcome variable (average breastfeeding rates by state), a policy variable (state-specific breastfeeding laws represented as our DID policy variable that takes the value of 1 for each time period t (i.e. year) after the legislation was enacted in a respective state, including the year of enactment, and 0 otherwise), and state-specific dummies identifying where and when the policy was enacted. We use representative datasets for these variables, the RMS and NIS, for our outcome variable and information of policy enactment from the National Conference of State Legislatures (2016) for our policy, state, and year variables. Although a robust estimate of the policy impact using DID can be obtained by using only these three groups of variables, we use the PSID and the CPS to control for state-level differences to improve precision of our estimate of the policy impact. Therefore, we run five specifications. M1: base DID specification with state fixed-effects and year fixed-effects; M2: main DID specification where we add state-level covariates; M3 (lag analysis): alternative specification where we estimate how long after policy introduction the policy started to have an impact upon breastfeeding rates. Our data does not allow us to directly observe when the policies were fully implemented by employers, thus, we split the policy effect into year effects (namely 1–2, 3–4, and 5 years) using lags to test for the effect of potential delays in implementation after enactment. For the first three specifications, states were considered treatment states if they had a policy enacted within our time period, and control states if they did not have a policy enacted. We run a fourth specification M4, where we define two treatment groups to assess if the enforceability of policies had a differential impact on breastfeeding rates. For M4, we split our treatment group into two: states with strict and weak enforceability of policies.

We also conduct a falsification test to address potential endogeneity issues and test the main assumption of DID, the parallel trends assumption (M5), which implies that in the absence of the treatment (legislation), control (states without legislation) and treatment (states with legislation) groups will follow common trends in the average outcome (breastfeeding rates) (Angrist & Pischke, 2008). We add indicator variables (leads) of 1–2, 3–4, and 5–6 years prior to policy enactment to test whether there were already systematic differences in breastfeeding rates prior to policy enactment between treatment and control states (Autor, 2003). If the parallel trends assumption is not violated the coefficients of the leads should not be statistically different from zero suggesting that there are no systematic differences between treatment and control states pre-policy, and therefore we can rely on DID for causal inference of the impact of the policy. See appendix C for further details on methodology.

4. Results

Descriptive statistics suggest that breastfeeding rates are higher among states post-policy at 44.8% compared to control states at 30.9% with the difference being statistically significant (Table 2). States with strict enforceability have higher breastfeeding rates compared to control states at 46.4% than states with weak enforceability at 42.4% (Table 3). Statistics also show that the average mothers' age is 28 years, and there is on average 1 child under 18 years of age per household. Mothers have on average 14 years of education.

Fig. 2 presents average unadjusted breastfeeding rates in the years before and after policy enactment for control and treatment states. We see that breastfeeding rates in treatment and control states follow an increasing parallel trend until time of policy enactment, at time t, followed by a stronger increase in t+2 and t+3 in treatment states. This suggests that there was an increase in breastfeeding in all states unrelated to the policy before policy enactment, which was possibly exacerbated in treatment states after enactment.

Table 4 presents estimates for M1-M5, and Fig. 3 presents the DID variables (the average policy impacts) of our main specifications M2 and M4 graphically. For all specifications, the effect of the policy (the treatment effect) is represented by the coefficients on the DID policy.

The results demonstrate that breastfeeding rates are higher in states with legislation when compared to states without legislation, controlling for demographic and economic covariates (M2). The legislation causes a statistically significant average increase of 2.3 percentage points in breastfeeding rates for treatment states. This increase is over and above a general increase in breastfeeding rates in all states over time. States with weak enforceability experience a greater increase in breastfeeding rates in comparison to controls (3.1 percentage points) than states with strict enforceability (1.6 percentage points), however the confidence intervals overlap and the difference between the coefficients are not statistically significant (Table 4).

The lag analysis (M3) shows that the policy does not have an impact until 1–2 years after being enacted, when there is an average increase of 2 percentage points in breastfeeding rates (Fig. 4). The policy continues

Table 2
Descriptive statistics on states pre- and post-policy enactment.

	Post-policy enactment Mean (Standard Deviation)	Pre-policy enactment Mean (Standard Deviation)	Difference in means (t-test p-value)
Proportion of children ever breastfed at 6 months	0.448 (0.113)	0.309 (0.128)	0.139 (0.000)
Average mothers' age	28.757 (3.232)	28.616 (3.335)	0.141 (0.663)
Average number of children in household under 18 years old	0.974 (0.103)	0.951 (0.137)	0.024 (0.021)
Average years of mothers' education	14.540 (1.444)	14.260 (1.492)	0.280 (0.053)
Average health expenditures per capita	$4255 ($1064)	$5171 ($988)	-$916 (0.000)
Proportion of married mothers	0.451 (0.051)	0.435 (0.053)	0.016 (0.000)
Proportion of White mothers	0.637 (0.209)	0.772 (0.158)	−0.135 (0.000)
Proportion of African American mothers	0.121 (0.123)	0.106 (0.119)	0.015 (0.114)
Proportion of Hispanic mothers	0.136 (0.133)	0.077 (0.095)	0.059 (0.000)
Median household income (in $1000)	$41,802 ($6009)	$39,193 ($6225)	$2609 (0.000)
Unemployment rate	0.062 (0.022)	0.055 (0.018)	0.007 (0.000)
Average mothers' hours per week on main job	30.929 (6.207)	29.788 (7.918)	1.142 (0.261)
Proportion of mothers in white collar jobs	0.755 (0.297)	0.753 (0.302)	0.003 (0.925)
Proportion of women in state legislature	0.244 (0.069)	0.212 (0.075)	0.033 (0.000)
State party affiliation[a]			
Democratic	0.576 (0.495)	0.427 (0.495)	
Republican	0.232 (0.423)	0.323 (0.468)	
Split	0.192 (0.395)	0.25 (0.433)	(0.000)
Observations	213	919	

Note: Standard deviations in parenthesis. Labor income and childcare costs are adjusted for inflation using the CPI index to 2000 $USD.
[a] A χ^2 was used for state party affiliation.

to have an impact after 1–2 years and averages to 3.6 percentage points 5 years after policy enactment. Finally, the lead analyses (M5: where we switch the policy variable on before the year of enactment) indicate that there is no policy endogeneity, i.e. treatment and control states follow common trends in average outcome breastfeeding rates (Table 4 and Fig. 4). This, together with parallel trends shown in Fig. 2, gives us confidence that the parallel trends assumption of DID is fulfilled and that we are identifying the effect of the policy change.

Our results also show significant associations between state-level covariates and breastfeeding rates. We find that states with higher average mothers' age and higher median household income have higher breastfeeding rates. There is evidence that maternal age is a strong predictor of breastfeeding and is positively associated with breastfeeding (Callen & Pinelli, 2004; Ong et al., 2005). Mothers from higher socioeconomic backgrounds also have increased incidence and prevalence of breastfeeding compared to mothers from lower socioeconomic backgrounds (Li et al., 2004; Ong et al., 2005). Finally, we find a strong negative association between the proportion of African-American mothers and breastfeeding rates across all models, M2-M5. The magnitude of this effect is approximately twice as large for African-American mothers compared to White mothers. The literature shows that there is racial disparity in breastfeeding behavior where African-American mothers have the lowest breastfeeding rates compared to women of other ethnicities (Forste, Weiss, & Lippincott, 2001; Singh, Kogan, & Dee, 2007).

5. Discussion and conclusion

We evaluate the impact of workplace breastfeeding policies on breastfeeding rates in the US, controlling for a broad range of confounding factors, a general increase in breastfeeding rates across the country, and time-variant unobserved differences across states with and without legislation. We show that workplace breastfeeding legislation has a positive and significant impact upon state breastfeeding rates. Rates are 2.3 percentage points higher as a direct effect of the legislation, although it takes about 1–2 years after enactment to have a measurable impact on breastfeeding rates. Impact in states where legal enforceability of the policy is weak is greater than in states where enforceability is strict, but the difference is not statistically significant. This study evaluates impact for employed mothers who breastfeed exclusively, but also for those who supplement breastmilk with other forms of infant food.

Our estimated policy impact of 2.3 percentage points means that implementing this policy across states without the policy would increase breastfeeding rates from 32% to 34.3%. There have been some studies estimating the economic impact of increased breastfeeding rates (Bartick & Reinhold, 2010; Rollins et al., 2016; Weimer, 2001). Rollins et al. (2016) estimates that if breastfeeding up to 6 months increased by 10 percentage points from current levels, $312 million can be saved due to treatment costs from childhood diseases in the US. Considering our estimate of 2.3 percentage points, a back of the envelope calculation suggests savings of approximately $72 million. These savings arise due to the well-documented health benefits of breastfeeding in form of reduced treatment costs for childhood and maternal illnesses (Fletcher, 2011; Singhal & Lanigan, 2007; Victora & Barros, 2000; Victora et al., 2015; WHO, 2000).

Our findings are larger in magnitude compared to the four existing empirical studies on the impact of US workplace breastfeeding legislation (Dozier & McKee, 2011; Hawkins et al., 2013; Kogan et al., 2008; Smith-Gagen et al., 2014). Hawkins et al. (2013) estimated a lower impact of workplace legislation for children breastfed for at least 4 weeks at 1.7 percentage points, but their study included mothers not in the labor force who are not affected by the policy and a restricted sample of only seven states observed over eight years, limiting the ability to capture the full effect of the policy, specifically in a context where they may be delayed implementation (Hawkins et al., 2013). Smith-Gagen et al. (2014) and Kogan et al. (2008) found that workplace legislation was associated with lower breastfeeding rates by 2 and 1.6 percentage points, respectively, while Dozier and McKee (2011) found no effect (Dozier & McKee, 2011; Kogan et al., 2008; Smith-Gagen et al., 2014). These studies either fail to address sample selection bias by only including a subset of treatment states, or they are limited due to

Table 3
Breastfeeding rates pre- and post-policy enactment, by enforceability, and treatment.

	Post-policy enactment of all treated states	Post-policy enactment of strict enforceability of states	Post-policy enactment of weak enforceability of states	Pre-policy enactment	Control states with no policy enactment[a]
Proportion of children ever breastfed at 6 months	0.448 (0.113)	0.464 (0.115)	0.424 (0.106)	0.309 (0.1238)	0.320 (0.130)
Observations	203	125	78	919	572

Note.
[a] This includes control states that never enacted a policy during our study period.

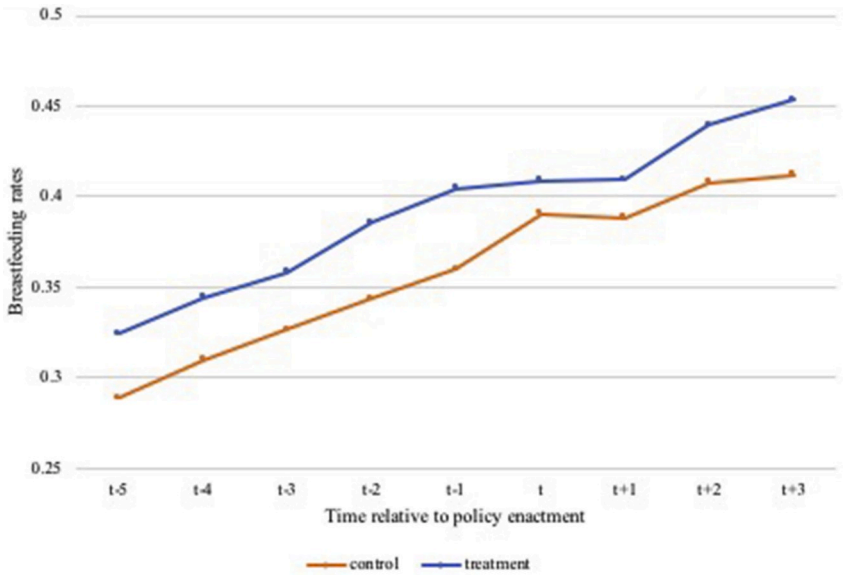

Fig. 2. Parallel trends graph of breastfeeding rates of control and treatment groups by time relative to policy enactment.
Note: The figure plots average unadjusted breastfeeding rates for treatment and control states relative to year of enactment t; year of enactment varies for treatment and their respective control states.

methodology, data quality, and short study periods making it difficult to compare findings with our study.

Our findings underline the importance of implementing workplace breastfeeding policies, and it is not even necessary to implement strict legislation to see significant beneficial impacts on breastfeeding. Despite convincing evidence on the efficacy of breastfeeding policies from our and other studies, there has been a worrying policy reversal in the US recently. The world was stunned when in July 2018, the US delegation vehemently opposed a World Health Resolution to encourage breast-feeding (Jacobs, 2018). American officials sought to weaken the resolution by modifying language that called on governments to "protect, promote and support breast-feeding" as well as another clause aimed at policymakers to restrict the promotion of baby food products such as formula-milk (Jacobs, 2018). This confrontation suggested that the recent administration would rather align itself with corporate interests over public health issues (Jacobs, 2018). Although many experts have highlighted the benefits of breastfeeding over formula-milk, the $70 billion industry largely monopolized by American and European companies continues to influence progress on breastfeeding policies (Jacobs, 2018). The incident highlights that policy makers must remain vigilant and thwart potential future efforts that could endanger the progress that has been made.

The expansion of breastfeeding breaks nationally (Kapinos, Bullinger, & Gurley-Calvez, 2017; Patient Protection and Affordable Care Act, 2010) established through the Affordable Care Act (ACA) is a step forward in promoting breastfeeding; the breastfeeding provision included in the ACA increased breastfeeding initiation by 2·5 percentage points (Kapinos et al., 2017). The recent attempt to repeal it emphasizes the importance of state-level policies to protect breastfeeding mothers when national policies cannot (Beck, 2017). This is clearly an open agenda, where legislators need to work towards defending the progress that has been made.

Our results also suggest that the policy does not have an impact on breastfeeding rates until 1–2 years after policy introduction, which may be due to delayed implementation by employers. Employers may have taken some time to fully implement policies due to enforceability issues in the policy design as few states actually enforce fines for employers who do not comply with the requirements of state policies. Moreover, mothers may not have been aware about workplace breastfeeding policies in the early years after implementation, or stigma about breastfeeding may have impeded mothers' intentions to breastfeed in the workplace.

The results should be considered in light of the limitations of this research. While we assess the differential effectiveness of the policy due to enforceability, only eight states have weak enforceability while a majority of states have strict enforceability of policies, resulting in low variation to account for this heterogeneity. Secondly, some of the covariates are aggregated at the state-and-year-level from the PSID. They rely on smaller samples of mothers for some states and years, which may result in measurement error of some of the covariates. However, this is unlikely to affect our results as we do not expect measurement error to be correlated with selection into the policy, and we are using a quasi-experimental research design in which the parallel trends assumption is not violated. We can also rely on DID for causal inference without covariates derived from the PSID as our outcome variable (breastfeeding rates) and variable of interest (DID policy variable) are from other representative datasets. Regardless, we have also included covariates from other data sources such as the CPS, which relies on a much larger sample compared to the PSID. Thirdly, as our outcome variable collects information 6 months after the birth of the child on a yearly basis, average breastfeeding rates in the treatment state in that year would be influenced by children not exposed to the policy for the first months of their lives if they were born between January and June in that year. This may bias downwards the estimated impact of the policy, i.e. makes it more conservative. However, we are estimating the impact of the policy over long periods, in the case of some states over a decade or longer. Moreover, our lag analysis shows that the policy leads to a significant impact only 1–2 years after implementation. We are, therefore, confident that a slight downward bias of our outcome variable in the year the legislation was passed is likely to have only a minor impact on the overall magnitude of our estimate. Finally, due to item non-response, the sample size of our models decreases when adding PSID covariates possibly leading to lower power to detect a policy impact. However, through a sample size calculation, we find that we have enough observations to find an effect size equal to ours (Faul et al., 2009). We additionally use a robust study design including several years of pre- and post-treatment data on our outcome variable, therefore, there is no issue of statistical power in the context of DID (McConnell & Vera-Hernandez, 2015).

Despite these limitations, our results provide important empirical

Table 4
Estimated impacts of US workplace breastfeeding legislation on the proportion of children ever breastfed at 6 months.

	M1	M2	M3	M4	M5
DID $_{\text{policy lead 5–6 years}}$					0.002 (−0.011, 0.014)
DID $_{\text{policy lead 3–4 years}}$					−0.001 (−0.015, 0.012)
DID $_{\text{policy lead 1–2 years}}$					0.012 (−0.002, 0.027)
DID $_{\text{policy effect}}$	0.182*** (0.164, 0.200)	0.023*** (0.011, 0.034)			0.026*** (0.012, 0.040)
DID $_{\text{introduction year}}$			0.011 (−0.010, 0.031)		
DID $_{\text{policy lag 1–2 years}}$			0.020*** (0.004, 0.036)		
DID $_{\text{policy lag 3–4 years}}$			0.025*** (0.008, 0.042)		
DID $_{\text{policy lag 5 years onwards}}$			0.036*** (0.018, 0.053)		
DID $_{\text{strict enforceability}}$				0.016* (0.001, 0.031)	
DID $_{\text{weak enforceability}}$				0.031*** (0.014, 0.047)	
Average mother's age (years)		0.001** (0.0003, 0.002)	0.001** (0.0002, 0.002)	0.001** (0.0002, 0.002)	0.001** (0.0002, 0.002)
Average number of children in household under 18 years old		0.007 (−0.034, 0.049)	0.007 (−0.034, 0.049)	0.008 (−0.036, 0.050)	0.007 (−0.035, 0.050)
Average years of mother's education		−0.002 (−0.004, 0.0005)	−0.002 (−0.004, 0.001)	−0.002 (−0.004, 0.0004)	−0.002 (−0.004, 0.0004)
Average health expenditures per capita		0.014 (−0.005, 0.034)	0.018* (−0.002, 0.037)	0.016 (−0.003, 0.036)	0.014 (−0.005, 0.034)
Proportion of married mothers		−0.053 (−0.162, 0.056)	−0.051 (−0.160, 0.058)	−0.053 (−0.162, 0.055)	−0.055 (−0.165, 0.054)
Proportion of White mothers		−0.275** (−0.542, −0.008)	−0.265* (−0.532, 0.001)	−0.262* (−0.529, 0.005)	−0.265* (−0.532, 0.002)
Proportion of African-American mothers		−0.407*** (−0.697, −0.118)	−0.379** (−0.669, −0.088)	−0.399*** (−0.689, −0.110)	−0.400** (−0.690, −0.109)
Proportion of Hispanic mothers		0.057 (−0.267, 0.381)	0.065 (−0.258, 0.389)	0.057 (−0.267, 0.381)	0.068 (−0.257, 0.393)
Median household income		0.002*** (0.001, 0.004)	0.002*** (0.001, 0.004)	0.002*** (0.001, 0.004)	0.002*** (0.001, 0.003)
Unemployment rate		−0.066 (−0.497, 0.365)	−0.012 (−0.445, 0.421)	−0.068 (−0.499, 0.362)	−0.075 (−0.507, 0.357)
Average mother's hours per week on main job		0.001 (−0.002, 0.0005)	0.0001 (−0.0003, 0.0005)	0.0002 (−0.0002, 0.0005)	0.0001 (−0.0003, 0.001)
Proportion of mothers in white-collar jobs		0.006 (−0.004, 0.016)	0.006 (−0.004, 0.016)	0.006 (−0.004, 0.016)	0.006 (−0.005, 0.016)
Proportion of women in state legislature		0.042 (−0.077, 0.160)	0.037 (−0.081, 0.156)	0.058 (−0.063, 0.179)	0.045 (−0.074, 0.164)
State party affiliation					
Republican		−0.002 (−0.013, 0.008)	−0.005 (−0.016, 0.006)	−0.004 (−0.015, 0.007)	−0.002 (−0.012, 0.009)
Split		−0.007 (−0.016, 0.002)	−0.009* (−0.018, 0.0004)	−0.008* (−0.017, 0.001)	−0.007 (−0.016, 0.002)
State fixed-effects	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes
Constant	0.301*** (0.295, 0.308)	0.296*** *0.182, 0.573)	0.274*** (−0.004, 0.552)	0.276* (−0.003, 0.555)	0.290** (0.012, 0.569)
Overall R^2	0.154	0.732	0.715	0.737	0.733
Observations	1112	561	561	561	561

Note: Sample sizes vary across specifications due to item non-response on some variables. M3 includes the introduction year, and lags of 1–2 years, 3–4 years, and 5 years onwards. The first three indicator variables are equal to 1 only in the relevant year and the last indicator is 1 in each year, starting with 5 years after the year of adoption. In M4 the policy effect is split by enforceability. M5 includes leads of 5–6 years, 3–4 years, 1–2 years, and the main DID policy effect. States where the legislation is of weak enforceability (i.e. only encourage employers to provide facilities and/or break time) include Georgia, North Dakota, Oklahoma, Rhode Island, Texas, Virginia, Washington, and Wyoming. States where the legislation is of strict enforceability (i.e. requires employers to provide facilities and break time) include Arkansas, California, Colorado, Connecticut, District of Columbia, Hawaii, Illinois, Indiana, Maine, Minnesota, Mississippi, Montana, New Mexico, New York, Oregon, Tennessee and Vermont. 95% CI in parenthesis. The base level for state-party affiliation is Democratic. Coefficient estimates for state-fixed effects year dummies available upon request to authors. *p < 0·10; **p < 0·05; ***p < 0·01.

evidence for policy makers concerned about increasing breastfeeding rates in the US. More research is needed to uncover the mechanisms through which workplace breastfeeding interventions impact breastfeeding rates. The impact of the policy found in this analysis, may be due to changes in workplace facilities as intended by the policy but can also be due to spillover effects of the policy such as an official and clear position on breastfeeding, public communication surrounding the legislation and the policy triggering higher levels of social desirability associated with breastfeeding. Although these were not intended objectives of the policy, knowing the specific mechanisms can help policy makers design efficient legislation to tackle lagging breastfeeding rates. Overall, the positive impact of this policy is encouraging for the long-

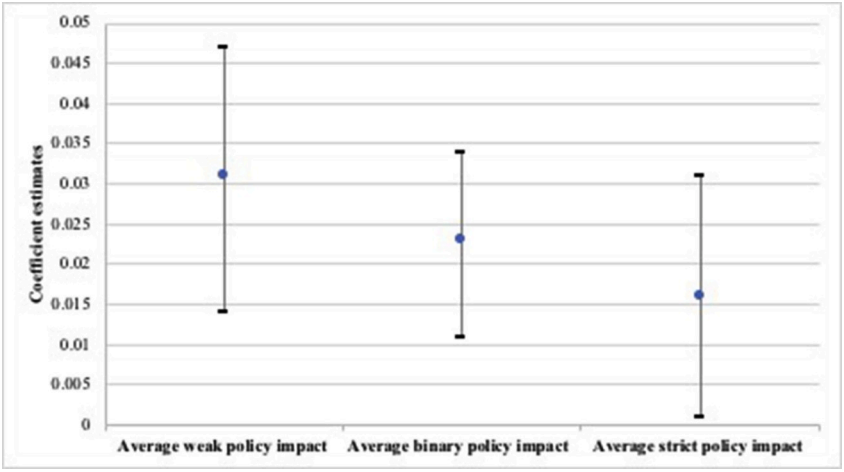

Fig. 3. Average impacts of state-level workplace breastfeeding policies on breastfeeding rates.
Note: The graph plots the estimated coefficients in blue. The vertical bands represent 95% CIs. Estimates differ by legal enforceability of the policies: the 'average weak policy impact'/'average strict policy impact' measures the impact of breastfeeding policies, which encourage/require employers to offer provisions to breastfeed at the workplace; the 'average binary policy impact' measures the combined impact of breastfeeding policies of either weak or strict enforceability. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

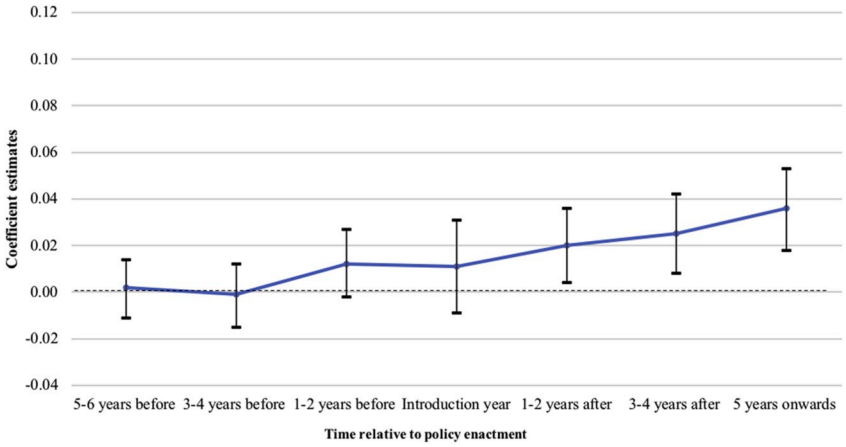

Fig. 4. Impact of state-level workplace breastfeeding policies on breastfeeding rates relative to year of policy enactment.
Note: The graph plots the estimated coefficients of the policy relative to year of enactment including leads and lags. The vertical bands represent 95% CI.

term health of children born to mothers who return to work shortly after giving birth and who are most at-risk for discontinuing breastfeeding at that time. Some commentators question whether the current emphasis on breastfeeding is justified by the scientific evidence, given the mental and emotional toll is can take on some women (Wolf, 2007). However, the World Health Organization and UNICEF recommend that all mothers breastfeed and continue to do so for up to two years (UNICEF, 2015). Although workplace policies can contribute to reaching the Healthy People breastfeeding goals by 2020 in the US, it may take several additional years to reach this objective due to low breastfeeding rates and the significant existing barriers to breastfeeding. Therefore, policies need to be implemented as part of a combination package of interventions aimed at improving take-up of breastfeeding for both employed and unemployed mothers such as limiting promotion of formula-milk, access to lactation counselling post-partum in hospitals, and the expansion of baby-friendly hospitals. Our results are encouraging for other countries with low breastfeeding rates where workplace policies can alleviate the key employment barrier to breastfeeding and thus, help mothers reconcile work and motherhood responsibilities.

Author statement

All authors contributed equally and so authors are in alphabetical order.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2020.100580.

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