World Medical and Health Policy

Paid Parental Leave Policies and Infant Mortality Rates in OECD Countries: Policy Implications for the United States

Dana Patton, Julia F. Costich, and Niklas Lidströmer

Infant mortality is an important indicator of a nation's overall health and well-being because of its association with education, availability and accessibility of health services, and income inequality. In this paper, we examine the effect of job-protected paid parental leave on infant and post-neonatal mortality rates in 19 OECD countries from 1960 to 2012. We utilize a generalized least squares model controlling for a host of variables traditionally examined in studies of infant mortality rates, as well as year fixed effects, country fixed effects, and country time trends. We find a statistically significant association between job-protected paid parental leave and a reduction in both infant mortality rates and post-neonatal mortality rates. The findings are particularly relevant for policymakers in the United States, the only industrialized democracy in the world that does not provide job-protected paid parental leave to working women and men.

KEY WORDS: paid parental leave, infant mortality rate, OECD countries

Introduction

Governments and employers implement paid parental leave to help workers maintain a healthy work–life balance, to retain workers (particularly women), to boost fertility rates in the context of aging national populations, to promote gender equality, and to enhance child and maternal health (International Labour Organization [ILO], 2014; Ruhm, 2011). The following analysis examines the effects of job-protected paid parental leave on child health, specifically on infant mortality rates and post-neonatal mortality rates, in 19 OECD countries. We begin with a brief discussion of the importance of infant mortality rate as a measure and how its changes over time have varied across countries. We then review previous findings regarding the effect of parental leave on the major types of infant mortality. Next, we highlight the United States as an outlier among its peers, in terms of both paid parental leave and infant death rates. Our analysis provides evidence that paid parental leave reduces the post-neonatal mortality rate, which recent research suggests is the primary driver of the high infant mortality rate in the United States

Published by Wiley Periodicals, Inc., 350 Main Street, Malden, MA 02148, USA, and 9600 Garsington Road, Oxford, OX4 2DQ.

(Chen, Oster, & Williams, 2016). We thus conclude with a discussion of the importance of adopting job-protected paid parental leave in the United States as a mechanism for reducing infant mortality.

Infant Mortality and Parental Leave

Infant mortality rate is considered a significant indicator of a nation's overall health (Anderson, 1973; Judge, Mulligan, & Benzeval, 1998; MacDorman, Mathews, Mohangoo, & Zeitlin, 2014; Nersesian, 1988; Reidpath & Allotey, 2003). A country's infant mortality rate is measured as the number of infant deaths before age 1 per 1,000 live births. Infant mortality falls into three major classes: (i) *Perinatal* mortality: fetal death from the 22nd week of gestation through the first postpartum week; (ii) *Neonatal* mortality: death of newborns within the first 28 days; and (iii) *Post-neonatal* mortality: deaths from day 28 through the rest of the first year of life. The major medical predisposing factors for infant mortality are low birth weight, malnutrition, sudden infant death syndrome (SIDS), and infectious diseases (Stevens-Simon & Orleans, 1999). Across all countries, about half of all infant mortality occurs within the perinatal and neonatal time frame (WHO, 2011). In the OECD countries, two thirds of infant deaths occur within this window, that is, during the first month (OECD, 2015a). It is important to distinguish between the perinatal/neonatal time frame and the post-neonatal time frame because the differences in causes of death suggest that different policy approaches may be needed for death occurring in each period (Heron, 2013; OECD, 2015b; Rudolph & Borker, 1987).

Over the past five decades, the infant mortality rate has fallen steadily in OECD countries (OECD, 2011). In 1970, the OECD average infant mortality rate was 30 deaths per 1,000 live births, whereas the current average is 4.3, representing an 85 percent cumulative reduction (OECD, 2012). Some OECD countries have enjoyed larger and more rapid infant mortality declines. The Nordic countries, Japan, and Portugal have the lowest infant mortality rates, ranging from 2.5 to under 3.0. The United States stands out with its rate of over 6.0 per 1,000 live births. In 2010, the U.S. rate dropped from 6.1 to 4.2 when births at less than 24 weeks of gestation were excluded, but the U.S. rate was still higher than those of most European countries (MacDorman et al., 2014). Using a small sample of countries with available microdata, Chen et al. (2016) show that infant mortality in the United States "accelerates after the first month of life" (91). Importantly, this finding holds for normal weight births, that is, the higher post-neonatal mortality rate is not driven by delaying death with extended intensive care unit stays.

Only a handful of studies have examined the relationship between paid parental leave and infant mortality rates. Winegarden and Bracy (1995) examined the effects of paid maternity leave across 17 OECD countries and four time periods. They found that paid maternity leave reduces infant mortality, but did not control for a variety of variables that may affect infant mortality. Ruhm (2000) improved on Winegarden and Bracy's research design, utilizing additional control variables

and examining data for 16 European countries from 1969 to 1994, and found that paid parental leave was associated with a decline in infant death rates. Tanaka (2005) added the United States and Japan to Ruhm's data set, extended the timeframe of study to 2000, and examined a variety of effects of paid parental leave. Tanaka found paid leave decreases infant mortality rates and affects some other aspects of child health. Moving beyond the OECD, Heymann, Raub, and Earle (2011) examined the effect of paid maternity leave across 141 countries, using a cross-sectional research design. They found a statistically significant association between paid maternity leave and lower infant mortality rates.

Most recently, Shim (2015) used data provided by Ruhm and Tanaka, extended the data to 2010, and added childcare leave to the variables measuring job-protected paid leave and "other leave" as appropriate. Shim reported that job-protected paid leave has a statistically significant effect on infant mortality rates; however, Shim did not control for low birth weight in the model using infant mortality rate as the dependent variable. Low birth weight is a well-documented cause of infant mortality and its exclusion from the model calls into question the true magnitude of the effect of paid leave on the infant mortality rate. In addition, it is unclear why one would expect childcare leave (leave that would occur after the first year of life) to affect the infant mortality rate.

Parental Leave and Infant Mortality in the United States

The social safety net in the United States differs from most of its OECD peers in myriad ways (Bradley et al., 2016). In this study, we examine one of these differences—job-protected paid parental leave—and its relationship to infant and post-neonatal mortality rates. Paid parental leave is correlated with a variety of outcomes that affect infant health. For example, parents who are offered paid leave are more likely to take time off work, to breast-feed, to extend the duration of breast-feeding, and to adhere to well baby check-ups and immunization schedules (e.g., Baker & Milligan, 2008; Berger, Hill, & Waldfogel, 2005; Khanam, Ngheim, & Connelly, 2016; Lingberg, 1996; Roe, Whittington, Fein, & Teisl, 1999; Ronsen & Sundstrom, 2002). Such positive influences on infant health may lead to a reduction in the infant mortality rate, a health indicator on which the United States has long underperformed compared to its peer countries. Among 29 developed nations, the United State ranks tewnty-sixth in infant mortality rates, behind nearly all of Europe, Japan, Korea, Israel, Australia, and New Zealand (MacDorman et al., 2014). Even if the substantial number of infant deaths at previability gestational ages are excluded, comparison with European countries finds that only Poland and Northern Ireland exceed the U.S. rate (MacDorman et al., 2014).

The United States is the only industrialized democracy that fails to provide job-protected paid parental leave to working women and men despite the status of paid maternity leave as a fundamental tenet of international work standards. For example, the International Labor Organization's Convention No. 183, ratified by some 43 member nations (ILO, 2014), sets a standard of a minimum 14 weeks paid leave. In contrast, the U.S. maternity leave mandate under the Family and Medical Leave Act

(FMLA) spans only 12 weeks; extends only to certain employees of employers of 50 or more workers; and importantly, includes no provision for payment.[1] Given the lack of compensation, it is not surprising that a large proportion of those eligible for FMLA-mandated leave do not take the full 12-week allotment. FMLA benefits, such as they are, cover only about 60 percent of the U.S. workforce. Large employers often provide paid leave, but U.S. national estimates suggest that only 13 percent of workers have access to employer-supported paid leave. The increasing proportion of U.S. workers in contingent (i.e., self-employed, part-time, seasonal, temporary) work arrangements further undermines such limited access to maternity leave as FMLA provides (Klerman, Daley, & Pozniak, 2014).

The Family and Medical Leave Insurance Act (S. 786 114th Congress 2015), as introduced in the U.S. Senate in 2015 proposes a combination of employer and employee funding to support paid leave for qualified parents up to 12 weeks, initially capped at $1,000 per week. This approach allows us to make a very rough estimate of costs associated with paid leave in the context of reducing infant mortality. Assuming most new parents would not qualify for the maximum support and would not take the maximum available leave, we reduce these two factors in the computation to plausible levels. Thus, if 75 percent of the 3.9 million annual U.S. births were associated with 6 weeks' paid leave at an average $800 per week, the total annual cost would be about $14 billion—a large number, but if that investment were associated with infant mortality reduction to the OECD mean of 4 per 1,000 live births, some 7,800 infants would be spared from early death. The cost per life, approximately $1.78 million, is far lower than the $9.2 million value of a statistical life used by the U.S. Department of Transportation to assess the cost-effectiveness of other lifesaving interventions.[2]

Despite the lack of nationally mandated paid parental leave, a few states, localities, and businesses have taken the lead in offering paid leave to workers. Three U.S. states (California, New Jersey, and Rhode Island) have implemented paid parental leave programs as add-ons to longstanding temporary disability insurance programs; New York has enacted similar legislation to be implemented in 2018, and Washington has enacted legislation that will be implemented when funding is available. California is the leader among these states with a paid leave policy adopted in 2004. A recent evaluation of the policy suggests positive effects on breast-feeding, time spent on childcare, increased time off by lower income women to care for newborns, and women's employment and earnings; 90 percent of employers reported no major problems with the policy (Bartel, Baum, Rossin-Slater, Ruhm, & Waldfogel, 2014). Despite these successes, the diffusion of paid leave policies throughout the states has been slow. In early 2015, President Obama issued a presidential memorandum to federal agencies instructing them to allow federal workers 6 weeks of paid leave following childbirth, adoption, or foster care placement. At the other end of the federalist spectrum, a few local governments, such as Austin, TX; Kansas City, MO; New York City; and Pittsburgh-Allegheny County, PA offer some paid leave time to new parents who are local government employees. Both the presidential memorandum and the few local government actions typically apply only to government workers, however,

and as local governments are "creatures of the state," such ordinances could be voided by state government.

In sharp contrast to the United States, most other industrialized democracies have had job-protected paid parental leave policies for decades, and some have extended the duration of paid parental leave well beyond the ILO benchmark. Our analysis assesses the relationship between job-protected paid parental leave and infant mortality using an exceptionally rich data set comprising 19 OECD countries with observations spanning 52 years (1960–2012). As noted above, few studies have examined this relationship and only three (Ruhm, 2000; Shim, 2015; Tanaka, 2005) utilize country panel data. These three studies use a common data set and method, finding similar results. The exclusion of low birth weight as a control variable and the inclusion of weeks of childcare leave by Shim in the model examining infant mortality rates is problematic, as noted earlier. Our study is an important contribution to this small body of literature in that our data begin earlier than previous studies, 1960, and we utilize a different method, generalized least squares (GLS) regression, to correct for serial correlation on a country-by-country basis. The findings suggest paid parental leave is a key component in the reduction of infant deaths, with its largest effect on post-neonatal deaths. This finding is particularly relevant for the United States given it does not have nationally mandated paid parental leave and has higher infant mortality rates than its peer countries. Indeed, recent research that shows "the United States has a substantial disadvantage relative to all comparison countries during the post-neonatal period . . ." (Chen et al., 2016).

Data Description and Methods

We use country panel data for the period 1960–2012 that includes 19 OECD countries.[3] When appropriate, missing values are estimated using interpolation. Data were obtained primarily from OECD databases (see Appendix A).

Two dependent variables are examined: the infant mortality rate and the post-neonatal mortality rate.[4] As shown in Figure 1, between 1960 and 2012, all countries experienced considerable declines in infant mortality rates.

The primary independent variable of interest is job-protected paid parental leave, measured in weeks. Data for 1960–69 are from Gauthier (2011) and cross-checked with PF2.5 Annex: Detail of Change in Parental Leave by Country (OECD, 2016). The 1970–2012 data are taken from the OECD Family Database PF2.5, which includes multiple measures of leave including maternity leave, parental leave, home care leave, and paternity leave reserved for the exclusive use of the father. We utilize one measure, job-protected paid parental leave, which we construct to include maternity leave weeks that are reserved exclusively for the mother around childbirth and the subsequent parental leave, which may be taken by either parent. Our measure does not include home care leave,[5] which some countries offer following maternity and parental leave, and which typically may be taken until the child is 2 or 3 years old. Our measure does not include weeks reserved exclusively for the father, as only a few countries have instituted

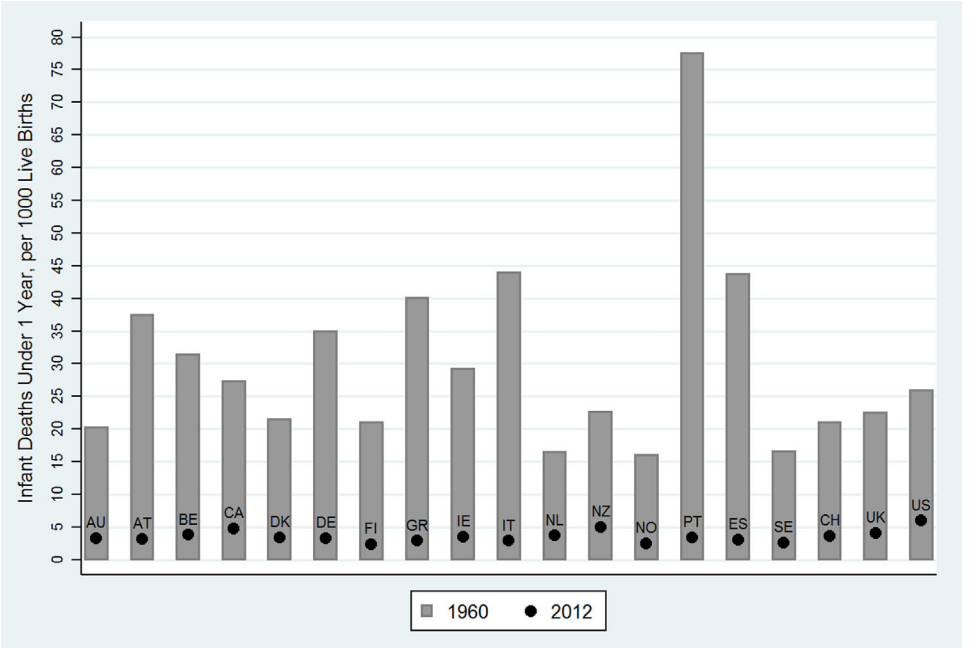

Figure 1. Infant Mortality Rates in 19 OECD Countries, 1960 and 2012.

such polices, they have been adopted relatively recently, and policy uptake has been slow. Table 1 lists the countries we examine and the total weeks of job-protected paid maternity and parental leave available in 2012.

Conceptually, it makes sense to consider maternity leave and parental leave as one measure, as we are interested in examining the effect of the total amount of available job-protected paid time off work to care for a child. Thus, we subtract the weeks of available paid home care (childcare) leave from the OECD Family Database PF2.5 that reports total weeks of paid maternity, parental, and home care leave. We duplicate this procedure for the two columns in the data set reporting job-protected maternity, paternity, and home care leave regardless of income support (i.e., paid and unpaid), and job-protected home care leave regardless of income support thus yielding the total weeks of job-protected maternity and parental leave available regardless of income support. We compare this new measure with the paid maternity and parental leave measure. In almost all cases, the number of weeks is identical or the job-protected maternity and parental leave regardless of income support variable is larger than the paid maternity and parental leave variable, thus allowing us to easily identify the number of weeks of job-protected paid maternity and parental leave.[6] Figure 2 displays a simple cross-sectional scatterplot of infant mortality rate by weeks of job-protected paid parental leave for two time periods, 1980 and 2012. Particularly interesting is the fact that five countries offered no weeks of job-protected paid parental leave in 1980, but by 2012, the United States was the only country in the sample still offering zero weeks and has the highest infant mortality rate of all the countries.

Table 1. Weeks of Job-Protected Paid Maternity and Parental Leave, 2012

Country	Weeks of Job-Protected Paid, Maternity, and Parental Leave
Australia	18
Austria	60
Belgium	32
Canada	52
Denmark	50
Finland	42
Germany	58
Greece	43
Ireland	26
Italy	48
Netherlands	42
New Zealand	14
Norway	35
Portugal	30
Spain	16
Sweden	60
Switzerland	14
United Kingdom	39
United States	0

Sources: OECD Family Database PF2.5. Some countries report leave in days rather than weeks. For these countries, the OECD database converts days of leave into weeks. We round these data for ease of presentation in the table. For example, working women and men in Portugal received 30.1 weeks of leave in 2012.

Research Design and Hypotheses

We estimate the impact of weeks of job-protected paid maternity and parental leave on infant mortality rate and the post-neonatal mortality rate. Our coefficient estimates are generated by a GLS regression, which corrects for serial correlation on a country-by-country basis.[7] The model includes year fixed effects, country fixed effects, and country time trends. We report "panel-corrected" standard errors to address panel heteroscedasticity (Beck & Katz, 1995). The model specification takes the form represented in equations (1) and (2):

$$\textbf{\textit{Infant Mortality}}_{i,t} = a_i + \beta_1 \textbf{\textit{Paid Parental Leave}}_{i,t} + \sum(\beta_i X_{i,t}) + \textbf{\textit{Year}}_t + \textbf{\textit{Trend}}_i + \varepsilon_{i,t} \quad (1)$$

$$\textbf{\textit{Post-Neonatal Mortality}}_{i,t} = a_i + \beta_1 \textbf{\textit{Paid Parental Leave}}_{i,t} + \sum(\beta_i X_{i,t}) + \textbf{\textit{Year}}_t + \textbf{\textit{Trend}}_i + \varepsilon_{i,t} \quad (2)$$

where ***Infant Mortality*** is measured as the natural log of the infant mortality rate, which is the number of infant deaths prior to age 1, per 1,000 live births; ***Post-Neonatal Mortality*** is measured as the natural log of the post-neonatal mortality rate, which is the number of infant deaths between day 28 and age 1,

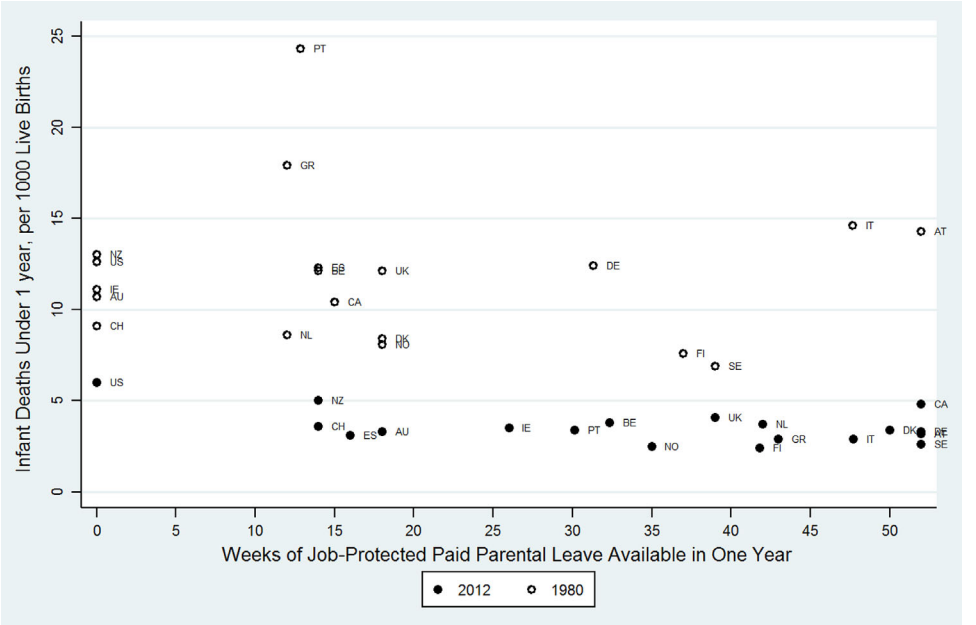

Figure 2. Scatterplot of Infant Mortality Rate and Weeks of Job-Protected Paid Parental Leave, 1980–2012.

per 1,000 live births; ***Paid Parental Leave*** is measured as the number of weeks of job-protected paid maternity and parental leave, per year; $\boldsymbol{X_i}$ is a series of control variables (detailed below); $\boldsymbol{\alpha_i}$ represents a series of country fixed effects; $\boldsymbol{Year_t}$ is a series of year fixed effects; $\boldsymbol{Trend_i}$ is a series of country-specific time trends; $\boldsymbol{\beta_1}$ in equation (1) represents the expected percentage change in the infant mortality rate, given a 1-week increase in paid parental leave; $\boldsymbol{B_1}$ in equation (2) represents the expected percentage change in the post-neonatal mortality rate, given a 1-week increase in paid parental leave.

Using this specification, we test the hypotheses:

Hypothesis 1: *As weeks of job-protected paid parental leave increases, the infant mortality rate will decrease (therefore* $\boldsymbol{\beta_1} < 0$*).*

Hypothesis 2: *As weeks of job-protected paid parental leave increases, the post-neonatal mortality rate will decrease (therefore* $\boldsymbol{\beta_1} < 0$*).*

Independent Variables

Our independent variables include our primary variable of interest, weeks of job-protected paid parental leave, as well as a series of control variables capturing the effects of other public policies, socioeconomic conditions, and public health measures.

Policy Variables

As indicated in Table 1, some countries offer more than 52 weeks of job-protected paid maternity and parental leaves. We measure our primary independent variable of interest, *Paid Parental Leave*, as an annual variable and thus 52 weeks is the maximum amount of job-protected leave available on an annual basis. Two additional policy variables are utilized as control variables: health expenditures and family benefits. *Health Expenditures* is a measure of public and private expenditures on health goods and services as a percentage of gross domestic product (GDP).[8] It is well documented that high spending on health care does not necessarily result in improved health outcomes, particularly when developed nations are compared (Bradley et al., 2016; Squires & Anderson, 2015). Therefore, we do not have an *Health Expenditures* on *Infant Mortality*. Our other policy variable, *Family Benefits*, is a measure of public spending that is exclusively for families with children.[9] It includes parental leave payments, cash transfers, child allowances, child tax allowances, childcare support, and other forms of financial assistance to families, but does not include health or housing spending. Family benefits is measured as a percentage of GDP and is expected to be associated with lower infant mortality rates.

Socioeconomic Variables

Following previous research (Ruhm, 2000; Shim, 2015; Tanaka, 2005), we include two variables that may be categorized as socioeconomic: female labor force participation and GDP. As noted by Tanaka (2005), *Female Labor Force Participation* may improve child health through increased income, but may also have a negative effect if it decreases the amount of time devoted to providing direct care. A country's GDP is expected to have a negative effect on infant mortality, as wealthier countries should be best poised to protect the health and welfare of their citizens.[10]

Health Variables

Three final control variables are included in the models. The *Total Fertility* rate of 15–44-year-old women is included as a control variable. As suggested by Ruhm (2000), fertility rate may have a positive relationship with infant deaths. The percentage of the population that is insured is included as well, with the expectation that *% Insured* will have a negative effect on infant mortality rates due to increased access to prenatal care and postnatal infant care.[11] The final health variable included is *% Low Birth Weight* due to its well documented contribution to infant mortality rates (WHO, 2011), measured as live births weighing less than 2,500 g expressed as a proportion of total live births.[12]

Results

The coefficient estimates for equation (1) are presented in Table 2. Model A presents results for 1960–2012 and includes all independent variables except

Table 2. Generalized Least Squares Panel Regression Estimates: Effect of Job-Protected Paid Parental Leave on Log of Infant Mortality Rate in 19 OECD Countries

Independent Variables	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0018 (.0008)*	−.0020 (.0008)**
Total fertility rate	.0442 (.0464)	.0589 (.0512)
Female labor force participation	.0018 (.0020)	−.0024 (.0022)
% Insured	.0010 (.0011)	−.0005 (.0007)
GDP	−.0103 (.0033)**	−.0075 (.0035)*
Health expenditures	−.0367 (.0092)**	−.0453 (.0094)**
% Low birth weight	.0465 (.0131)**	.0450 (.0120)**
Family benefits		.0364 (.0158)*
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	19	19
N (observations)	681	579
R-squared	.99	.99

Note: All models include panel-corrected standard errors in parentheses.
*p-value <.05; **p-value <.01.

Family Benefits. Model B retains all the variables tested in Model A and adds *Family Benefits*, reducing the estimation years to 1980–2012. In both models, *Paid Parental Leave* has a statistically significant negative effect on *Infant Mortality Rate*. The results suggest a 1-week increase in job-protected paid parental leave would result in a .2 percent decrease in the infant mortality rate. Thus, a 12-week increase in job-protected paid leave would yield a 2.4 percent reduction moving a country with an infant mortality rate of 6 deaths per 1,000 live births to 5.856 deaths per 1,000 live births.

Health Expenditures and *GDP* were both negative and statistically significant; as the percentage of low birth weight births increases, the infant mortality rate increases. In Model B, *Family Benefits* is significant, but not in the expected direction.

Post-Neonatal Mortality Rates

Given that approximately two thirds of all infant deaths across the OECD countries occur during the perinatal and neonatal periods and are due to prematurity, congenital anomalies, and other perinatal conditions (OECD, 2015a), we estimate equation (2) utilizing post-neonatal mortality rates as the dependent variable.[13] We expect the effect of paid leave time may have a stronger effect on post-neonatal infant mortality rates than on infant mortality rates given some differences in causes of death. Post-neonatal mortality rates, as explained earlier, capture infant deaths between 28 days and 1 year of age; the primary causes for such deaths among developed countries are Sudden Infant Death Syndrome, persistent effects of congenital malformations, injuries, and infections (Heron, 2013; OECD, 2015b). The new dependent variable captures infant deaths that are more likely to be classified as preventable and thus more likely to be influenced

by paid parental leave. This effect may be due not to the presence of a parent alone, but also reduction of work and financial stress.

The results are presented in Table 3. Following the same estimation strategy as with infant mortality rates, we first estimate the model for the time period 1960–2012 and exclude one control variable, *Family Benefits*, due to missing data. We find *Paid Parental Leave* has a negative and statistically significant relationship with *Post-Neonatal Mortality Rate*. In Model B, presented in the table, we add the additional control variable, *Family Benefits*, and the model estimation time reduces to 1980–2012. A 1-week increase in *Paid Parental Leave* results in an expected decrease of approximately .3 percent of post-neonatal deaths per 1,000 live births. Hence, a 12-week increase in paid parental leave would result in an approximate 3.6 percent decrease in post-neonatal mortality. This would result in a decline in the post-neonatal mortality rate, for example, from approximately 2 deaths to 1.928 post-neonatal deaths per 1,000 live births.

Across all models with both dependent variables, *Health Expenditures* is consistently negatively related to infant mortality and post-neonatal mortality at statistically significant levels. Job-protected paid leave for working parents and public and private spending on health results in fewer infant deaths. The results further suggest that policies that reduce the number of low birth weight infants will result in a reduction of the infant mortality rate.

Conclusions and Policy Implications

In this research, we build on a small number of studies that have examined the relationship between parental leave policies and infant

Table 3. Generalized Least Squares Panel Regression Estimates: Effect of Job-Protected Paid Parental Leave on Log of Post-Neonatal Mortality Rate in 19 OECD Countries

Independent Variables	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0032 (.0011)**	−.0031 (.0013)*
Total fertility rate	.0487 (.0697)	.1006 (.0788)
Female labor force participation	.0075 (.0031)*	−.0017 (.0038)
% Insured	.0022 (.0021)	.0015 (.0020)
GDP	−.0066 (.0052)	.0001 (.0058)
Health expenditures	−.0302 (.0136)*	−.0435 (.0158)**
% Low birth weight	.0215 (.0212)	−.0144 (.0227)
Family benefits		.0111 (.0233)
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	18	19
N (observations)	646	577
R-squared	.95	.94

Notes: All models include panel-corrected standard errors in parentheses. Model A excludes New Zealand due to missing data for post-neonatal mortality rate from 1960 to 1972.
*p-value <.05; **p-value <.01.

mortality rates in OECD countries. The policy implications are clear for the United States: instituting job-protected paid parental leave will save infant lives. In particular, our results speak directly to the finding by Chen et al. (2016) regarding higher post-neonatal mortality rates in the United States compared to peer countries. Chen et al. (2016) note that policy efforts targeting reduction in the infant mortality rate in the United States have largely been directed toward the prevention of preterm births, stating it has "received a tremendous amount of policy focus" whereas reduction of the post-neonatal mortality rate "has to the best of our knowledge received very little attention" (p. 118).

Based on our analyses, the projected infant mortality reduction from 6 to 5.856 per 1,000 live births would approximately result in 576 fewer deaths per year, with the post-neonatal mortality reduction (from 2 to 1.928 per 1,000 live births) yielding some 288 avoided deaths per year. These estimates are likely to be conservative in both scope and magnitude because they are based on data from nations that already have comprehensive mandates for paid leave of varying duration, in contrast with the absence of a similar policy in the United States.[14] Our data present an additional limitation in that we are estimating an average effect at the country level. Hence, any variability across subpopulations is not estimated, leading us to generalize effects to everyone and potentially overlooking effects for groups such as low income where the effects may be more significant.

Paid parental leave policies have growing support in the United States. The public sector is leading current local and national parental leave initiatives. President Obama's fiscal 2017 budget proposal again endorses paid parental leave to federal employees, and as noted earlier, some cities have adopted paid leave for city employees. While these local efforts are important, policies that target only government employees are most likely missing the most vulnerable population: new parents with lower socioeconomic status whose children are at greatest risk of post-neonatal death (Chen et al., 2016). The early-adopting state of California, for example, found significant positive relationships with return to employment and earnings (Bartel et al., 2014). These findings imply that, to the extent that parents can be financially supported so that they can return to the workforce, the social cost of parental leave may be offset in part by lower costs for cash assistance and government-funded health insurance, while employers' costs could be offset because increased worker retention reduces the costs of recruiting and training new workers (O'Connell & Kung, 2007). Elevating the U.S. ranking among industrialized nations on the critical indicator of infant mortality can be achieved with a national policy, as our research demonstrates.

Dana Patton, PhD, is an associate professor of Political Science at the University of Alabama.
Julia F. Costich, JD, PhD, is a professor in the Department of Health Services Management, and also serves as an associate director of the Kentucky Injury Prevention and Research Center.

Niklas Lidströmer, MD, Specialist Gen. Med., MSc., CEO/Founder GlobeDoc GmbH, Zug, Switzerland.

Notes

Conflicts of interest: None declared.

Corresponding author: Dana Patton, dana.patton@ua.edu

1. See http://www.dol.gov/whd/regs/compliance/whdfs28.pdf.
2. See https://www.transportation.gov/sites/dot.gov/files/docs/VSL_Guidance_2014.pdf.
3. Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Greece, Ireland, Italy, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. France is excluded due to missing data for low birth weight. Rather than estimate multiple models with and without low birth weight, we opt to exclude France from the analysis and include low birth weight in all models given its well documented effect on infant mortality. Unlike previous studies, our analysis includes Australia, New Zealand, and Canada.
4. Post-neonatal death rate data are missing in 2011 for Belgium and 2012 for Belgium, Canada, and Ireland.
5. Homecare leave is also referred to as childcare leave in some countries.
6. Ireland is an exception in the earlier years of the data set, having 12 weeks of paid maternity leave, but zero weeks of job-protected leave noted in the data set. We consulted the PF2.5 Annex Ireland country report to verify paid leave was available for those years, but it was not job-protected until 1981.
7. Our primary results reported in the main text of the paper rely on a GLS transformation that allows for the magnitude of serial correlation (AR1) to vary by country. Given the heterogeneity of the countries in the sample, we believe that it is unlikely the magnitude of error dependence is identical across the entire sample. However, we also estimated the models using two alternative methods that assume a common autocorrelation process—a GLS method that relies on a single estimate of the autocorrelation coefficient (rho) and an OLS model that includes a lag of the dependent variable as a regressor. These results are reported in Appendix B. Although there are some differences in these estimates, the results are generally consistent with the results reported in the text. That is, paid family leave is generally associated with improvements in public health.
8. Numerous measures of health expenditures are available. We opted for a measure that includes both public and private health expenditures, as we expect our dependent variable may be affected by health spending from all sources. Health Expenditures data are missing from 1960 to 1969 for Austria, Belgium, Canada, Denmark, Germany, Finland, Ireland, New Zealand, Norway, Portugal, Spain, Switzerland, and the United States; from 1960 to 1987 for Italy; from 1960 to 1971 for the Netherlands; from 1960 to 1984 for Sweden.
9. Family Benefits data are missing in 2012 for Austria, Belgium, Denmark, Germany, Finland, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.
10. GDP data are missing in 1960–69 for Austria, Belgium, Canada, Germany, Finland, Greece, Ireland, Italy, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United States; in 1960–65 for Denmark; in 1960–68 for the Netherlands.
11. % Insured data are missing in 1960 for Canada, Greece, Ireland; in 2012 for Spain.
12. % Low Birth Weight data are missing in 1960 for Canada; in 1960–81 for Belgium, Spain; in 1960–82 for Australia; in 1960–72 for Germany; in 1960–78 for Greece, the Netherlands, Switzerland; in 1960–83 for Ireland; in 1960–79 for Italy, New Zealand, Portugal; in 1960–66 for Norway; in 1960–69 for United States.
13. The post-neonatal death rate reported for Denmark in 2006 was an extreme outlier in our data. The value for 2005 is reported by the OECD as 1.1 per 1,000 live births, while the 2006 value is reported as .3. But by 2007, the value had risen again to 1.0. The magnitude of the reduction in the post-neonatal death rate is extremely unusual. It seems especially implausible given the fact that decrease in the infant mortality rate over the same period is not nearly as large (although it did decrease in 2006). Because the duration of paid leave offered in Denmark falls at the very high end of the distribution, the observation for 2006 exerts a large amount of influence on the paid parental leave coefficient, our primary independent variable of interest. The effect of this influence is to cause the coefficient value for paid parental leave effect to be stronger (i.e., the coefficient value is more strongly negative) than would be the case if that observation was removed from the sample.

Indeed, when we estimated the model with the data that includes the original value for 2006, this resulted in a paid parental leave coefficient for Model A of −.0046 and for Model B of −.0039 (with both reaching statistical significance). As a result, we felt that the best course of action was to replace the 2006 outlier value with an interpolated value (i.e., the average of the 2005 and 2007 value). These results are reported in Table 3. The coefficient for paid parental leave remains significant in both Models A and B, with the coefficient values of −.0032 and −.0031, respectively.

14. This also reflects a conservative estimate due to altering the 2006 post-neonatal death rate for Denmark (see footnote 11). When the original data for Denmark is used in the model, the projected post-neonatal decline is from 2 to 1.88 deaths per 1,000 live births, thus yielding an approximate reduction of 480 post-neonatal infant deaths per year instead of 288.

References

Anderson, James G. 1973. "Causal Models and Social Indicators: Toward the Developments of Social System Models." *American Sociological Review* 38: 285–301.

Baker, Michael, and Kevin Milligan. 2008. "Maternal Employment, Breastfeeding, and Health: Evidence from Maternity Leave Mandates." *Journal of Health Economics* 27: 871–87.

Bartel, Ann, Charles Baum, Maya Rossin-Slater, Christopher Ruhm, and Jane Waldfogel. 2014. "California's Paid Family Leave Law: Lessons from the First Decade." Report prepared for the U.S. Department of Labor, contract number DOL-OPS-14-C-0003. http://www.dol.gov/asp/evaluation/reports/paidleavedeliverable.pdf. Accessed January 17, 2016.

Beck, Nathaniel and Jonathan N. Katz. 1995. "What To Do (and Not To Do) with Times-Series Cross-Section Data in Comparative Politics." *American Political Science Review* 89: 634–47.

Berger, Lawrence M., Jennifer Hill, and Jane Waldfogel. 2005. "Maternity Leave, Early Maternal Employment and Child Health and Development in the US." *The Economic Journal* 115: F29–47.

Bradley, Elizabeth H., Maureen Canavan, Erika Rogan, Kristina Talbert-Slagle, Chima Ndumele, Lauren Taylor, and Leslie A. Curry. 2016. "Variation in Health Outcomes: The Role of Spending on Social Services, Public Health, and Health Care, 2000-09." *Health Affairs* 35: 760–68.

Chen, Alice, Emily Oster, and Heidi Williams. 2016. "Why Is Infant Mortality Higher in the United States Than in Europe?" *American Economic Journal: Economic Policy* 8: 89–124.

Gauthier, Anne H. 2010. "Comparative Family Database, Version 3 [computer file]." Netherlands Interdisciplinary Demographic Institute and Max Planck Institute for Demographic Research (distributors). http://www.demogr.mpg.de/en/. Accessed January 23, 2016.

———. 2011. "Comparative Family Database, Version 3 [computer file]." Netherlands Interdisciplinary Demographic Institute and Max Planck Institute for Demographic Research (distributors). http://www.demogr.mpg.de/en/. Accessed January 23, 2016.

Heron, Melonie. 2013. "Deaths: Leading Causes for 2010." *National Vital Statistics Reports* 62: 1–97. http://www.cdc.gov/nchs/data/nvsr/nvsr62/nvsr62_06.pdf. Accessed February 15, 2016.

Heymann, Jody, Amy Raub, and Alison Earle. 2011. "Creating and Using New Data Sources to Analyze the Relationship Between Social Policy and Global Health: The Case of Maternal Leave." *Public Health Reports* 126: 127–34.

International Labour Organization (ILO). 2014. *Maternity and Paternity at Work: Law and Practice across the World* [Online]. Geneva, Switzerland: Author. http://www.ilo.org/wcmsp5/groups/public/-dgreports/-dcomm/-publ/documents/publication/wcms_242615.pdf. Accessed February 29, 2016.

Judge, Ken, Jo-Ann Mulligan, and Michaela Benzeval. 1998. "Income Inequality and Population Health." *Social Science and Medicine* 46: 567–79.

Khanam, Rasheda, Son Ngheim, and Luke Connelly. 2016. "The Effects of Parental Leave on Child Health and Postnatal Care: Evidence from Australia." *Economic Analysis and Policy* 49: 17–29.

Klerman, Jacob Alex, Kelly Daley, and Alyssa Pozniak. 2014. "Family and Medical Leave in 2012: Technical Report." Prepared for U.S. Department of Labor. https://www.dol.gov/asp/evaluation/fmla/FMLA-2012-Technical-Report.pdf. Accessed on June 28, 2016.

Lingberg, Laura. 1996. "Women's Decisions About Breastfeeding and Maternal Employment." *Journal of Marriage and the Family* 58: 239–51.

MacDorman, Marian F., T. J. Mathews, Ashna Mohangoo, and Jennifer Zeitlin. 2014. "International Comparisons of Infant Mortality and Related Factors: United States and Europe, 2010." *National Vital Statistics Reports* 63: 1–6. http://www.cdc.gov/nchs/data/nvsr/nvsr63/nvsr63_05.pdf. Accessed February 13, 2016.

Nersesian, William S. 1988. "Infant Mortality in Socially Vulnerable Populations." *Annual Review of Public Health* 9: 361–77.

O'Connell, Matthew, and Mei-Chuan Kung. 2007. "The Cost of Employee Turnover." *Industrial Management* 49: 14–19.

Organisation for Economic Co-operation and Development (OECD). 2011. "Infant Mortality." In *Health at a Glance; 2011: OECD Indicators*. OECD Publishing. https://doi.org/10.1787/health_glance-2011-en. Accessed February 29, 2016.

———. 2012. *OECD Factbook* (Edition 2012) [Online]. OECD Factbook Statistics (database). DOI: https://doi.org/10.1787/data-00589-en. Accessed February 29, 2016.

———. 2015a. *Health at a Glance: 2015* [Online]. OECD Indicators, OECD Publishing, Paris. DOI: https://doi.org/10.1787/health_glance-2015-en. Accessed February 15, 2016.

———. 2015b. *Infant Mortality* [Online]. OECD Publishing, Paris. http://www.oecd.org/els/family/CO_1_1_Infant_mortality.pdf. Accessed February 29, 2016.

———. 2016. *PF2.5 Trends in Leave Entitlements Around Childbirth Codebook* [Online]. OECD Publishing, Paris. https://www.oecd.org/els/family/PF2_5_Trends_in_leave_entitlements_around_childbirth.pdf. Accessed June 17, 2016.

Reidpath, Daniel D., and Pascale Allotey. 2003. "Infant Mortality Rate as an Indicator of Population Health." *Journal of Epidemiology & Community Health* 57: 344–46.

Roe, Brian, Leslie A. Whittington, Sara Beck Fein, and Mario F. Teisl. 1999. "Is There Competition Between Breast Feeding and Maternal Employment?" *Demography* 36: 157–72.

Ronsen, Marit, and Marianne Sundstrom. 2002. "Family Policy and After-Birth Employment Among New Mothers—A Comparison of Finland, Norway and Sweden." *European Journal of Population* 18: 121–52.

Rudolph, Claire S., and Susan R. Borker. 1987. *Regionalization: Issues in Intensive Care for High Risk Newborns and Their Families*. Santa Barbara, CA: Praeger.

Ruhm, Christopher. 2000. "Parental Leave and Child Health." *Journal of Health Economics* 19: 931–60.

———. 2011. "Policies to Assist Parents with Young Children." *The Future of Children* 21: 37–68.

Shim, Joyce. 2015. "Family Leave Policy and Child Mortality: Evidence from 19 OECD Countries from 1969–2010." *International Journal of Social Welfare* 25: 1–7.

Squires, David, and Chloe Anderson. 2015. "U.S. Health Care from a Global Perspective: Spending, Use of Services, Prices, and Health in 13 Countries." *The Commonwealth Fund* 15: 1–16. http://www.commonwealthfund.org/publications/issue-briefs/2015/oct/us-health-care-from-a-global-perspective. Accessed February 20, 2016.

Stevens-Simon, Catherine, and Miriam Orleans. 1999. "Low-Birthweight Prevention Programs: The Enigma of Failure." *Birth* 26: 184–91.

Tanaka, Sakiko. 2005. "Parental Leave and Child Health Across OECD Countries." *The Economic Journal* 115: F7–28.

The Family and Medical Leave Insurance Act, S.786, 114th Congress (2015). https://www.congress.gov/bill/114th-congress/senate-bill/786. Accessed February 23, 2016.

Winegarden, C. R., and Paula M. Bracy. 1995. "Demographic Consequences of Maternal-Leave Programs in Individual Countries: Evidence from Fixed-Effects Models." *Southern Economic Journal* 61: 1020–35.

World Health Organization (WHO). 2011. *Newborn Death and Illness* [Online]. http://www.who.int/pmnch/media/press_materials/fs/fs_newborndealth_illness/en/. Accessed February 29, 2016.

Appendix A: Variable Measurement and Sources.

Variables	Measurement	Source
Job-protected paid parental leave	Number of weeks of job-protected paid maternity and parental leave, per year.	OECD Family Database PF2.5; Gauthier (2011)
Total fertility rate	Average number of children a woman would have if lived to end of childbearing years (15–44) and bear children in alignment with prevailing age-specific fertility rates. Measured in children/woman.	OECD Family Database SF2.1
Female labor force participation	Female civilian labor force as a percentage of the female population age 15–64 years.	Gauthier (2010); OECD Labor Force Statistics; ILO Labour Statistics; UN Department of Economic and Social Affairs, Population Division
% Insured	Percentage of the population with insurance, public and private.	OECD Social Protection Database; Centers for Disease Control and Prevention
GDP	Gross domestic product measured in U.S. thousands of dollars per capita (using PPP).	OECD National Accounts Statistics Database
Health expenditures	Public and private health expenditures measured in U.S. dollars as a percentage of GDP (using PPP).	OECD Health Expenditure and Financing Database
% Low birth weight	Number of live births weighing less than 2,500 g as a proportion of total live births.	OECD Family Database CO1.3
Family benefits	Benefits related to three categories of policies: child-related cash transfers to families with children, public income support payments during parental leave; public spending on services for families with children. Does not include health or housing expenditures. Measured as percentage of GDP.	OECD Social Protection Database
Infant mortality rate	The number of deaths of children under age 1 that occurred in a given year, per 1,000 live births.	OECD Family Database CO1.1
Post-neonatal mortality rate	The number of deaths of children between age 28 days and one year that occurred in a given year, per 1,000 live births.	OECD Family Database CO1.1

Appendix B: Alternative Estimations of the Effect of Job-Protected Paid Parental Leave on Log of Infant Mortality Rate and Log of Post-Neonatal Mortality Rate in 19 OECD Countries.

Table B1. Effect of Job-Protected Paid Parental Leave on Log of Infant Mortality Rate Using Estimation Method GLS (Common AR1)

	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0011 (.0008)	−.0020 (.0009)*
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	19	19
N (observations)	681	579
R-squared	.97	.97

Notes: All models include panel-corrected standard errors in parentheses. Model A includes Total Fertility Rate, Female Labor Force Participation, % Insured, GDP, Health Expenditures, % Low Birth Weight. Model B includes Family Benefits, in addition to all the control variables from Model A.
*p-value $<.05$.

Table B2. Effect of Job-Protected Paid Parental Leave on Log of Post-Neonatal Mortality Rate Using Estimation Method GLS (Common AR1)

	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0023 (.0013)	−.0038 (.0014)**
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	18	19
N (observations)	646	577
R-squared	.92	.94

Notes: All models include panel-corrected standard errors in parentheses. Model A includes Total Fertility Rate, Female Labor Force Participation, % Insured, GDP, Health Expenditures, % Low Birth Weight. Model B includes Family Benefits, in addition to all the control variables from Model A. Model A excludes New Zealand due to missing data for post-neonatal mortality rate from 1960 to 1972.*
*p-value $<.01$.

Table B3. Effect of Job-Protected Paid Parental Leave on Log of Infant Mortality Rate Using Estimation Method OLS (Lagged Dependent Variable)

	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0006 (.0007)	−.0023 (.0008)**
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	19	19
N (observations)	691	579
R-squared	.98	.98

Notes: All models include panel-corrected standard error estimates in parentheses. Model A includes Total Fertility Rate, Female Labor Force Participation, % Insured, GDP, Health Expenditures, % Low Birth Weight. Model B includes Family Benefits, in addition to all the control variables from Model A.
**p-value <.01.

Table B4. Effect of Job-Protected Paid Parental Leave on Log of Post-Neonatal Mortality Rate Using Estimation Method OLS (Lagged Dependent Variable)

	Model A: 1960–2012 Coefficient (Standard Error)	Model B: 1980–2012 Coefficient (Standard Error)
Paid parental leave	−.0005 (.0012)	−.0026 (.0011)*
Year fixed effects	Yes	Yes
Country fixed effects	Yes	Yes
Country time trends	Yes	Yes
N (countries)	18	19
N (observations)	657	579
R-squared	.96	.96

Notes: All models include panel-corrected standard errors in parentheses. Model A includes Total Fertility Rate, Female Labor Force Participation, % Insured, GDP, Health Expenditures, % Low Birth Weight. Model B includes Family Benefits, in addition to all the control variables from Model A. Model A excludes New Zealand due to missing data for post-neonatal mortality rate from 1960 to 1972.
*p-value <.05.