TECHNICAL REPORT:

Unintended and Inequitable Impacts of a 2017 Policy Change for License-Exempt Home Child Care

David Alexander, Illinois Action for Children. July 18, 2022

This is the technical report on research described in the policy research brief, "Unintended and Inequitable Impacts of a 2017 Policy Change for License-Exempt Home Child Care."[1] The study explores impacts of a federal child care subsidy policy change – one part of the CCDBG reauthorization of 2014 – as enacted by Illinois in 2017 to require license-exempt home-based child care providers – also called "family, friend and neighbor" (FFN) child care providers – for the first time to take preservice training in health and safety and child development. Appendix 1 has policy details. Immediately following this policy change, subsidized license-exempt home-based child care declined sharply in Illinois. Although stakeholder response to this was muted in the midst of other policy and financial changes in the subsidy program, it appears now that impacts were substantial and negative for equity: for example, many Black children and school-age children left the child care subsidy program. Hence we need a rigorous study of impacts.

General assumptions. The study assumes that subsidized FFN providers would react to the subsidy policy announcement as a burden since it imposes costs upon them in terms of time and monetary expenses. Furthermore, the rewards for complying (see Appendix 1) might or might not be sufficient to incentivize compliance with the new policy rules. Some FFN providers would drop out of the subsidy program and perhaps out of child care altogether. Under the new circumstances, parents with the subsidy might leave the subsidy program because they want to remain with their provider or because they cannot find a new provider who accepts the subsidy, offers a suitable schedule and meets the parents' other needs. As a result some children might leave the subsidy program.

Research Questions

Provider Study: Did the announced Illinois Child Care Assistance Program (CCAP) policy requiring subsidized FFN providers to complete health and safety training reduce the number of FFN providers in CCAP? If so, how large was the impact?

Child Study: Did the announced CCAP policy requiring subsidized FFN providers to complete health and safety training reduce the number of CCAP children in FFN care? If so, how large was the impact, and what can administrative data tell us about where the children went?

[1] Research presented in this brief was conducted as part of a larger research project, "Policy Reform to Advance Equity in Illinois Child Care Subsidy Program," funded by the Robert Wood Johnson Foundation, Julia R. Henly, PI (Professor University of Chicago) and David Alexander, co-PI (Director of Research, Illinois Action for Children).

Interrupted Time Series Data and Method

This technical report focuses on the main analysis implemented to answer the research questions. The analytic method follows interrupted time series with a control group (CITS). This is a quasi-experimental method that allows us to attribute causality to an intervention and measure its impact on a sample or population over time.[2] In this case, the announcement and rollout of new health and safety training requirements from February 2017 through September 2017 is the intervention, and the effective date of the policy, October 1, 2017, begins the post-intervention period. The provider study models the monthly number of CCAP FFN providers as the intervention or treatment group and the monthly number of CCAP licensed family child care (FCC) providers as the comparison group. The child study uses the monthly number of CCAP children in FFN care as the intervention group and the monthly number in licensed family child care as the control group.

Data

All data for the analyses come from administrative data files of the Illinois Child Care Assistance Program (CCAP), except for Illinois employment data published by the Illinois Department of Employment Security (IDES).[3] CCAP data include monthly program participation of children and providers and IDES data include employments totals. CCAP data cover the entire population of CCAP participants, while IDES data are based upon a household sample. We were limited to the January 2016 - April 2019 time period because (as explained below) earlier than January 2016 CCAP participation was unstable following a policy-induced program-eligibility cut in July 2015; and later than April 2019, an unrelated policy (extending eligibility from 6 months to 12) artificially and temporarily boosted monthly CCAP totals, and COVID soon followed. This time period provides data for 14 months pre-intervention, 7 months of intervention and 19 months of post-intervention data. The period is too short to pick up seasonal patterns in CCAP participation, and that is a potential weakness of the study. There were no missing data.

CCAP participation includes two types of home-based child care providers, licensed family child care homes (FCC care) and license-exempt child care homes (FFN care), and the children in those types of home-based child care. Child care centers appear in Figures 1 and 2 below but not in the analysis. Information on the timing of CCAP policy changes comes from CCAP notices and other documents of the Illinois Department of Human Services, the state agency that houses/administers the CCAP program.

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[2] Hategeka C., Ruton H., Karamouzian M., *et a*l. "Use of Interrupted Time Series Methods in the Evaluation of Health System Quality Improvement Interventions: A Methodological Systematic Review" (2020). *BMJ Global Health*; and Zhang, F., Wagner, A., Soumerai, S., Ross-Degnan, D. "Methods for Estimating Confidence Intervals in Interrupted Time Series Analyses of Health Interventions" (2009). *Journal of Clinical Epidemiology* 62 (2009) 143-148.

[3] Illinois Action for Children received permission from the Illinois Child Care Assistance Program to analyze CCAP data. Data collection took place independently of the intervention.

Children in FFN care function as an intervention group in the Interrupted Time Series analysis and children in FFC child care function as a control group, and it is thus important to compare demographic characteristics of each group of children. Table 1 shows that children in FFN and FCC care are mostly similar by race, age and family income as a percentage of the federal poverty level. A few differences stand out and could limit the validity of using children in FCC care as a control group: FFN care tends to have larger shares of Black and school-age children, and smaller shares of Latinx and younger children and families above 150 percent of the federal poverty level. If providers in these groups systematically reacted to the policy change differently, the results reported later might be biased.[4]

Table 1. Demographic Shares of Children in FFN and FCC Child Care

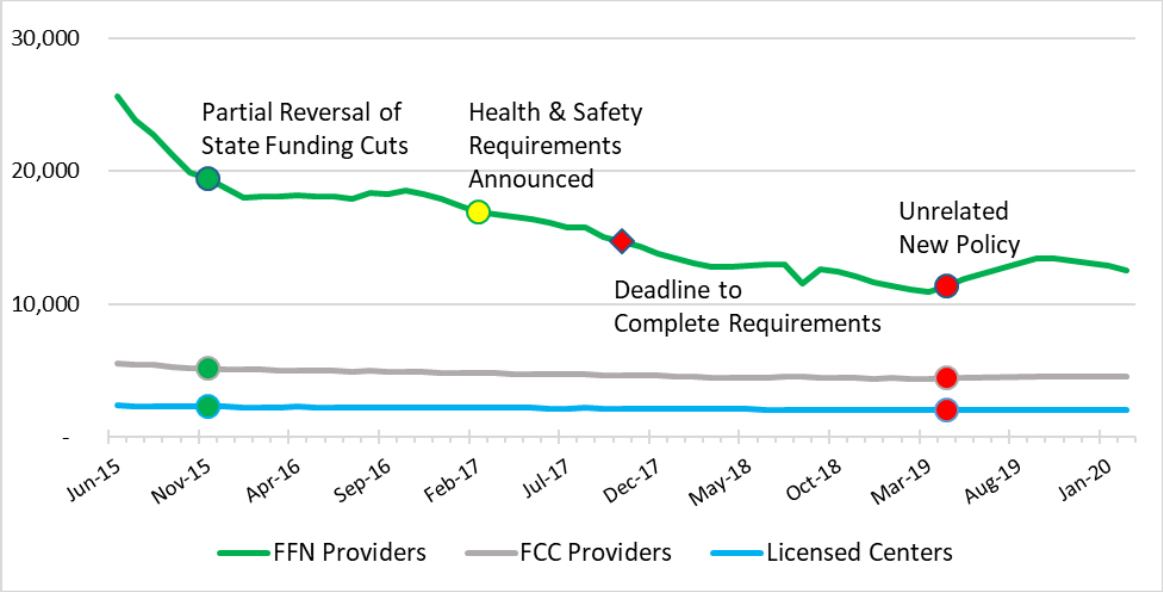
	Percent of FFN Care in CCAP, Feb. 2017	Percent of FCC Care in CCAP, Feb. 2017
CCAP Children		
Latinx	13%	26%
Black	65%	44%
White	10%	10%
Asian American	< 1%	< 1%
Two or More Races	5%	3%
Age < 2	12%	16%
Age 2	8%	11%
Ages 3 & 4	15%	20%
Age 5	7%	8%
Ages 6 to 12	58%	45%
CCAP Families (Percent at federal poverty levels)		
< 51% of federal poverty level	26%	22%
51 - 100% of FPL	26%	25%
101-150% of FPL	21%	25%
151-200% of FPL	16%	24%
Note: Data come from the Illinois Department of Human Services monthly CCAP payment files.		

Trends in subsidized FFN providers: Figure 1 shows trends for Illinois *providers* of the three major types of child care in CCAP over the period of study. As Figure 1 illustrates, state child care funding cuts in July 2015 (far left of trends) sharply lowered the number of providers in all three types of child care in CCAP. A partial reversal of the state cuts stabilized this trend (flattened the trend lines) at a lower number of providers beginning about November 2015 (the green dots on the left). For licensed center and licensed home care, the trends fell slightly until about March 2019 (red dots), particularly in FCC care, a decline that is hardly visible at the scale shown. At that point, the impact of an

[4] Modeling Black, Latinx and White children separately, however, shows that impacts of the policy announcement were similar but were larger and deeper for Black children. These are presented later.

unrelated policy temporarily boosted the number of providers in subsidized care.[5] While the number of providers of licensed care was relatively stable for about 3.5 years after November 2015, providers of FFN care resumed falling as early as one year later, November 2016 and continued until this care also received the boost from the unrelated policy after March 2019 (the red dot). The number of FFN providers in CCAP fell by about 5,900 (35 percent) during this time. The study period covers the months from the green dots to the red dots. As shown, the new health and safety training requirement announcement occurred in February 2017 (yellow dot), eight months before the effective date of October 1, 2017 (red diamond).

Figure 1. *Providers in Child Care Assistance Program by Type of Care, June 2015 – Feb. 2020*



Trends in subsidy children using FFN care: Figure 2 shows comparable trends since June 2015 in the three major types of child care in CCAP as measured by the number of children in care: licensed center-based care, FFN care, and FCC care.

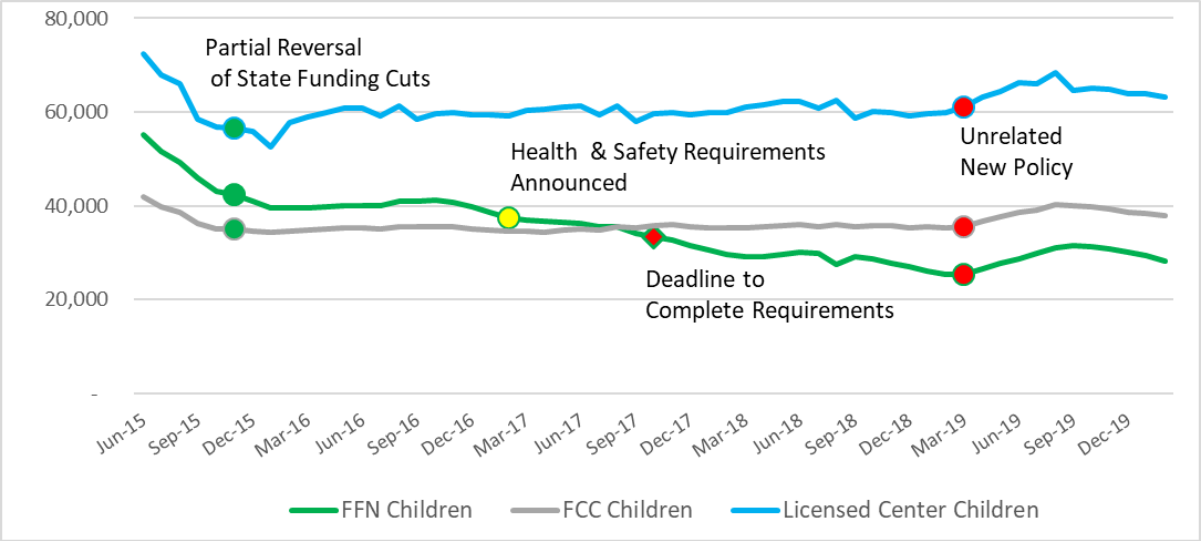
As Figure 2 illustrates, state child care funding cuts in July 2015 (far left of trends) sharply lowered the number of children in all three types of child care in CCAP. A partial reversal of the state cuts stabilized this trend (flattened the trend lines) at a lower number of children beginning about November 2015 (the green dots on the left). For licensed center and licensed home care, the trends remained flat or rose slightly until about March 2019 (red dots). At that point the impact of the unrelated policy temporarily boosted the number of children in subsidized care.[6] While the number of children in licensed care was largely stable for about 3.5 years after November 2015, children in FFN care resumed falling as early as November 2016 and continued until this

[5] The policy, effective October 2018, extended 6-month CCAP eligibility periods to 12 months. The policy began to increase CCAP cases 6 months after taking effect, and since parents renew their eligibility in different months, this increase lasted for one year until all 6-month cases were 12-month cases.

[6] See footnote 5.

care also received the boost from the new policy after March 2019. This study examines the new health and safety training requirements for FFN providers as they were announced in February 2017 (yellow dot). The red diamond shows the announced deadline of October 1, 2017 for FFN providers to comply with the new regulations. To summarize, in Figure 2 the green dots and the red dots indicate the beginning and end of our study period, a period of relative stability for children in licensed center and home care, but for FFN care a period of brief stability followed by a decline of more than 10,000 children.

Figure 2. *Children with Child Care Assistance by Type of Care, June 2015 – Feb. 2020*



Timing of Intervention. One limitation of this study is that in retrospect there is some ambiguity about the timing of FFN providers' learning about the new health and safety training requirements, and even exactly when it was announced. Documents support two different dates. Initially we explored models with both an 11-month phase-in from November 2016 to the announced effective date of October 2017 (not marked on Figures 1 and 2), and a 7-month phase-in, from February 2017 to the effective date, October 2017 (shown as yellow dot on Figures 1 and 2). Using the earlier data in the analysis gives somewhat larger policy impacts and closely coincides with the start of the long-term downturn in FFN children and providers in Figures 1 and 2. However, to align with the official announcement and to keep estimates of the policy impacts conservative, we focused on the 7-month phase-in, beginning with a February 2017 letter announcing the new health and a safety regulations and the effective policy date of October 1, 2017.

Analysis

Fitting these data with segmented regression in the statistical program R, we estimated interrupted time series models of the number of FFN providers and the number of children in FFN care over time. The regression models controlled for other independent

variables, including monthly employment numbers in Illinois and an unrelated restoration of CCAP eligibility during the study period. Models were robust for different covariates. They were subjected to appropriate tests for biased estimates and were corrected as appropriate. Most notably, we tested the time series with a Durbin Watson analysis and autocorrelation function and partial autocorrelation function plots. Tests did not indicate that autocorrelation is an issue for the provider data, but over-dispersion is, and we were able to estimate a generalized linear model with a quasi-Poisson distribution that exploits count data and accommodates over-dispersion in the provider data. In the child data over time, however, tests found an autoregressive and moving average structure. The child models were thus estimated with generalized least squares regressions to accommodate an ARMA(4,4) correlation structure.

Provider Model. We modeled the monthly number of providers as a linear function of time and several other variables. We define these below and describe the way we structured the data set and some variables to serve an interrupted time series analysis. We report results of fitting the following equation, where t is a month from January 2016 through April 2019 except for the 7-month intervention period, (March 2017 through September 2017).

$$\text{Providers}_t = \beta_{0t} + \beta_{1t}\,\text{Time} + \beta_{2t}\,\text{Time}^3 + \beta_{3t}\,\text{FFN} + \beta_{4t}\,\text{FFN*Time} + \beta_{5t}\,\text{PolicyFeb17} + \beta_{6t}\,\text{PolicyTrend} + \beta_{7t}\,\text{FFN*Policy} + \beta_{8t}\,\text{FFN*PolicyTrend} + \beta_{9t}\,\text{1PctEmployment} + \beta_{10t}\,\text{R185Time}^2 + \epsilon_t$$

Tests showed that autocorrelation is not an issue in the data, and this made it possible to fit the data with generalized linear model (GLM) so that we could take advantage of the fact that our data are counts (take no negative values) and far from zero. Because of over-dispersion in the data, we fit the data with a quasi-Poisson regression (with a log link), rather than Poisson regression. (R code for calling this model appears in Appendix 4.)

Structure of dataset: The dependent variable **Providers** has 66 monthly observations over 33 months. The first 33 observations are the monthly total number of providers in FFN child care in CCAP in Illinois from January 2016 through October 2019, with the 7 months of the intervention period (March 2017 through September 2017) removed. In the rectangular data file, these monthly observations are stacked on top of the same 33 months of observation for the control group, providers in *FCC child care*. Stacked in this way, the dependent variable Providers is a column of 66 observations. The other model variables are stacked similarly either repeating the first 33 observations (e.g. monthly Illinois employment) or structured for an interrupted time series model as described below.

Covariates: **FFN** is 1 if the provider is an FFN provider in CCAP (the first 33 elements) and 0 if the provider is an FCC provider (the second 33 elements). Its estimated coefficient picks up the level of FFN providers above the estimated intercept.

Time is the count of months from 1 through 33, and beginning on the 34th element repeats itself, 1 through 33. An additional variable raises Time to the third power (**Time^3**)

to allow for nonlinear relationship with time. While adding Time^3 improves the model fit slightly as measured by the Akaike information criterion (AIC), it does not substantially alter the estimated coefficients.

FFN*Time is the interaction of FFN and Time (and is thus always 0 for FCC); it picks up trends in FFN.

The announced health and safety training requirement intervention variable is **PolicyFeb17** and is 1 if the month is October 2017 or later, and is 0 for earlier pre-intervention months. **PolicyTrend** is the count of months following the intervention, 1 through 19, and 0 for each of 14 pre-intervention months. It picks up post-intervention trends in the control variable FCC, and is not expected *to be significantly different from zero*, since under the assumption of the model design, the control group is not affected by the intervention or treatment. To the extent that PolicyTrend is different from zero, we assume that it picks up the impacts of confounding factors at the time of the policy intervention that the model does not successfully incorporate.

The main variables of interest are (1) **FFN*Policy,** the interaction of FFN and PolicyFeb17, which is 1 for FFN providers during the post-intervention period, and 0 for pre-intervention FFN and is always 0 for FFC providers; and (2) **FFN*PolicyTrend**, the interaction of FFN and PolicyTrend. The estimated coefficient of the first measures the immediate level change in number of FFN providers after the intervention, and the second gives the post-intervention *change in trend* of FFN providers.

Two other factors are included as possible confounders. ***1PctEmployment*** is one percent of monthly Illinois employment.[7] Higher employment is assumed to increase the demand of child care. **R185Time^2** is the square of Time beginning October 2017 when CCAP restored the maximum CCAP eligible income to 185 percent of the federal poverty level, following emergency CCAP cuts to 50 percent of FPL in July 2015 and only partial restoration to 162 percent of FPL in November 2016 to re-stabilize CCAP. Presumably, this liberalization of CCAP eligibility gradually increased demand for child care in the months following the policy's announced effective date.

The intercept is the number of FCC providers if all other variables are 0.

Results of the Provider Model

The model was estimated in R. The results of two versions of the model, with and without Time^3, are in Table 2 below.

Note that the exponentiated linear coefficients are relative risks that when they are below 1.0 indicate a negative relationship between the predictor variable and the

[7] We used one percent of employment only for the convenience of reading the coefficient, though the positive values in our coefficient tables are still too small to register when rounded to 4 decimal places.

outcome variable (here FFN providers), and when they are above 1.0, a positive relationship. Thus for the key indicator, FFN*Policy, 0.84 indicates that an immediate drop in FFN providers of (1 minus 0.84) or 16 percent followed the intervention. And for the other key indicator, FFN*PolicyTrend, 0.986 indicates that each month following the intervention, the number of FFN providers fell 1.4 percent. In the first month following intervention the drop was roughly 17.4 percent (16 plus 1.4 percent).

Table 2. Two Provider Model Estimates

	Model 1		Model 2	
	Exponentiated β (Relative Risk)	p-value	Exponentiated β (Relative Risk)	p-value
(Intercept)	1934.682	0.0000	1646.9336	0.0000
Time	0.9962	0.2337	0.9939	0.0006
$Time^3$	1.0000	0.3733	-	-
FFN	3.5795	0.0000	3.5797	0.0000
FFN*Time	1.0026	0.1837	1.0026	0.1832
PolicyFeb17	0.9867	0.5863	0.974	0.1866
PolicyTrend	1.0004	0.9152	0.9986	0.6551
FFN*Policy	0.8407	0.0000	0.8407	0.0000
FFN*PolicyTrend	0.9863	0.0000	0.9863	0.0000
1PctEmployment	1.0000	0.0007	1.0000	0.0000
$R185Time^2$	1.0010	0.2505	1.0002	0.0451
Residual Deviance (degrees of freedom)	174 (55)	0.0000	176 (56)	0.0000

A χ^2 test of the residual deviance at the given degrees of freedom indicates that the model fit as a whole is not particularly good. The wide 95 percent prediction intervals shown later reflect this variance, although they nevertheless establish that the policy intervention had a significant impact.

Given that our quasi-Poisson GLM model sufficiently fits the data before and after the health and safety training announcement policy intervention, we can fit a regression curve to the number of providers in FFN care in each post-intervention month. These fitted regression values appear in Appendix 2, along with the fitted values for providers in FCC care and in Figure 3 below. For each estimate, we calculated 95 percent prediction intervals. These prediction intervals surround estimates of individual new values and are not the narrower confidence intervals that surround the regression line fit as a whole. The statistical package R has tools available for calculating prediction intervals for GLM models, and we used the boot package for R.[8] The 95 percent prediction intervals are shown in Appendix 2 and in Figure 3.

[8] In particular we used the boot_pi() function.

Measuring Policy Impact:

We define the policy intervention's impact at any point in time as the difference between what the number of FFN providers would have been in the absence of the intervention and the actual number of providers in that month post-intervention:

Policy impact on FFN Providers ≡ FFN providers without intervention – Actual FFN providers

The number of FFN providers in the absence of intervention is a counterfactual concept with unobservable values, and we must estimate its values for different points in time, as we do below. The actual number of FFN providers has an observed value at different points in time, but for consistency we will use the estimated values provided by the fitted GLM regression. Thus for any point in time,

Estimated Policy impact on FFN Providers ≡ Estimate of FFN providers without intervention *minus* Model-fitted estimate of FFN providers.

Creating a counterfactual time series of providers in FFN care. To estimate a counterfactual time series of FFN providers, we re-estimate the model without the post-intervention FFN level and trend variables, FFN*Policy and FFN*PolicyTrend. The estimated counterfactual time series will (1) coincide with the factual time series of FFN providers before the intervention, but (2) post-intervention gives a new series of FFN-provider values over time. The resulting time series of FFN providers thus reflects pre-intervention FFN trends and post-intervention trends in the control group of FCC providers, which by assumption is not affected by the policy intervention. In Interrupted Time Series analysis, we expect the post-intervention FCC level and trend coefficients (PolicyFeb17 and PolicyTrend) to be zero or small. To the extent that those coefficients are significant and substantial, however, we expect them to pick up the net influence of any confounding factors that are not explicitly included in the model and to pass this influence on to the estimate of the counterfactual time series of FFN providers. We can thus infer that the constructed counterfactual series reflects how the number of FFN providers would have trended without the policy intervention.

Figure 3 shows the actual levels of providers in FFN care (black dots along solid red line) and FCC care (black dots along solid blue line) during the study period, January 2016 through April 2019. The vertical dashed black line represents the 7-month policy intervention – from the February 2017 announcement of required health and safety training to October 1, 2017 when untrained providers would lose their payments. The trend in FCC providers is our comparison group: it tells us how a group unaffected by the policy had trended. Since it is a group of providers in a similar type of care, it indicates how FFN providers would have trended without the intervention. The red and blue lines themselves are the fitted linear regression model. The green dotted lines are 95 percent prediction intervals around the estimates.

The horizontal dashed red line from October 2017 to April 2019 is the counterfactual prediction of what the number of FFN providers would have been without the policy

intervention. The vertical difference between this dashed red line and the solid red line each month measures the impact of the announcement of the health and safety training mandate. Table 3 shows the cumulative impact in the first through the seventh month following the 7-month policy phase-in. The estimated impact in the first month (October 2017) was a loss of 2,988 providers in subsidized FFN care, or 17 percent of the predicted October 2017 level. That is the sum of the coefficients of FFN*Policy and FFN*PolicyTrend (in month 1 following the intervention). Six months later in April 2018 (at the vertical dotted red line), the cumulative impact was a loss of 4,020 providers, or 25 percent of the predicted April 2018 level.

Figure 3. Providers with Child Care Assistance in FFN & FCC homes, before and after health and safety policy phase-in (Feb. – Oct. 1, 2017).

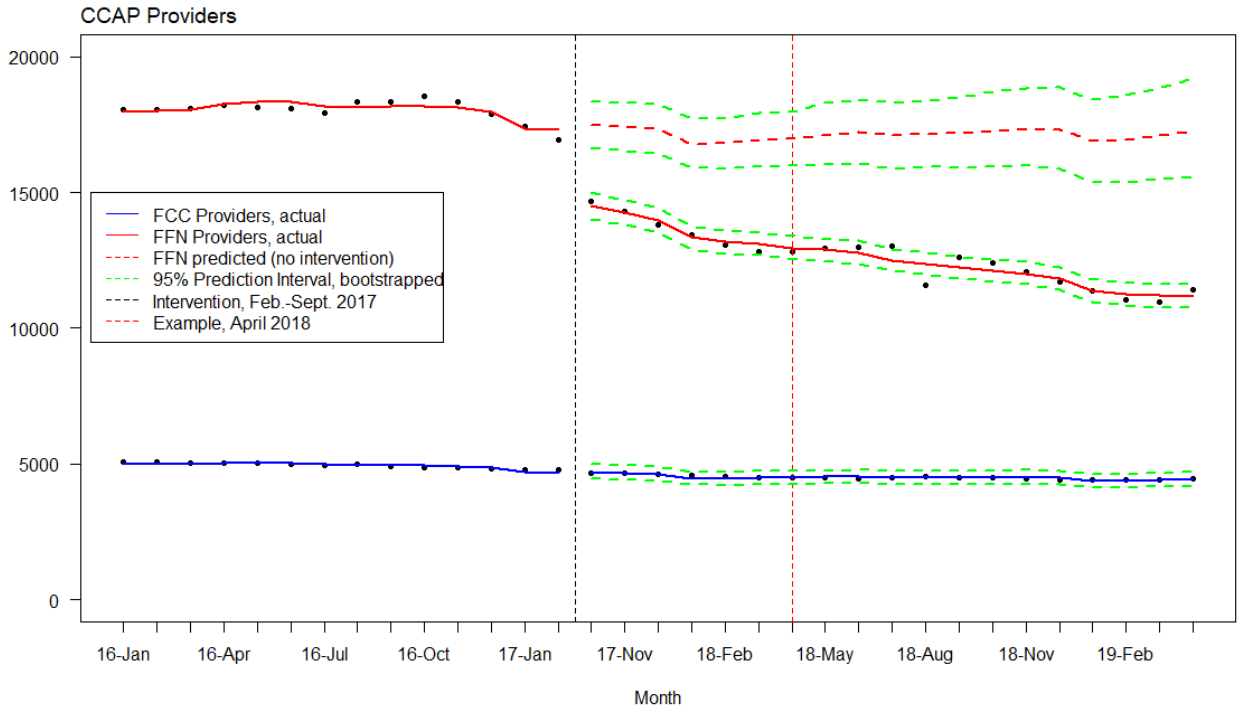


Table 3.

Estimated Impact of New Health & Safety Training Requirements Announcement on FFN Providers in CCAP (using policy phase-in period of February 2017 to October 1, 2017). Estimated impact is relative to the predicted number of FFN providers. Reported impacts are cumulative to that month.							
	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18
Change in Subsidized FFN Providers	-2,988	-3,179	-3,354	-3,430	-3,624	-3,830	-4,020
Percent Change	-17%	-18%	-19%	-20%	-22%	-23%	-24%

Child Model. We modeled the monthly number of children as a function of time and several other variables as defined below. We fit this model to the data in a generalized linear regression (GLS) with maximum likelihood estimation and a data structure specified as autoregressive and moving average, over time – specifically ARMA(4,4). (Code in R for calling this model appears in Appendix 4.)

$$\text{Children}_t = \beta_{0t} + \beta_{1t}\,\text{Time} + \beta_{2t}\text{Time}^2 + \beta_{3t}\,\text{Time}^3 + \beta_{4t}\text{FFN} + \beta_{5t}\,\text{FFN*Time} + \beta_{6t}\text{PolicyFeb17} +$$

$$\beta_{7t}\,\text{PolicyTrend} + \beta_{8t}\,\text{FFN*Policy} + \beta_{9t}\text{FFN*PolicyTrend} + \beta_{10t}\text{1PctEmployment} + \beta_{11t}\,\text{R185Time}^2 + \epsilon_t$$

Structure of dataset: The dependent variable **Children** has 66 monthly observations over 33 months. The first 33 observations are the monthly total number of children in FFN child care in CCAP in Illinois from January 2016 through October 2019, with the 7 months of the intervention period (March 2017 through September 2017) removed. In the rectangular data file, these monthly observations are stacked on top of the same 33 months of observation for children in *FCC child care*. Stacked in this way, the dependent variable Children is a column of 66 observations. The other model variables are stacked similarly either repeating the first 33 observations (e.g. monthly Illinois employment) or structured for an interrupted time series model as described below.

Covariates: **FFN** is 1 if the child is in FFN care in CCAP (the first 33 elements) and 0 if the child is in FCC care (the second 33 elements). Its estimated coefficient picks up the level of FFN children above the estimated intercept.

Time is the count of months from 1 through 33 that beginning on the 34th element repeats itself, 1 through 33. Two additional variables raise Time to the second and third power (**Time^2 and Time^3**) to allow for nonlinear relationships. While these improve the model fit as measured by AIC, they do not substantially alter the estimated coefficients.

FFN*Time is the interaction of FFN and Time (and is thus always 0 for FCC); it picks up trends in FFN.

The announced health and safety training requirement intervention variable is **PolicyFeb17** and is 1 if the month is October 2017 or later, and is 0 for earlier pre-intervention months. **PolicyTrend** is the count of months following the intervention, 1

through 19, and 0 for each of 14 pre-intervention months. It picks up post-intervention trends in the control variable FCC, and is expected *not to be significantly different from zero*, since under the assumption of the model design, the control group is not affected by the intervention or treatment.

The variables of interest are (1) **FFN*Policy,** the interaction of FFN and PolicyFeb17, which is 1 for FFN children during the post-intervention period, and 0 for pre-intervention FFN and is always 0 for FFC children; and (2) **FFN*PolicyTrend**, the interaction of FFN and PolicyTrend. The first measures the immediate level change in number of FFN children after the intervention, and the second gives the post-intervention *change in trend* of FFN children.

Two other factors are included as possible confounders. ***1PctEmployment*** is one percent of monthly Illinois employment (one percent only for convenience of reading the coefficient). **R185Time^2** is the square of Time beginning October 2017 when CCAP restored the maximum CCAP eligible income to 185 percent of the federal poverty level (following emergency CCAP cuts to 50 percent of FPL in July 2015 and only partial restoration to 162 percent of FPL in November 2016 to re-stabilize CCAP).

The intercept is the number of FCC children if all other variables are 0.

Preliminary analysis of the Child data indicate that they have an autoregressive structure – estimated as AR(4) – and a moving average structure – estimated as MA(4). Consequently, the model is estimated with a generalized least squares (GLS) regression with an ARMA (4,4) specification.

Results of child model.

Estimates of two versions of the child model appear in Table 4. Unlike the quasi-Poisson estimation of the provider model, GLS coefficients here have the familiar interpretation of linear coefficients. Our analysis uses the estimates of Model 1, but we include Model 2 to show some less stable properties of these estimates. Model 2 does not have the values of Time raised to powers that Model 1 has, but Model 2 includes dummy variables for August 2018, a month that is a wild data point (and probable measurement error).

These differences in the models shift the intercept values by a large amount. Perhaps more importantly they change the estimated coefficients of key intervention variables: Model 1 has larger coefficients for FFN*Policy (the intervention's immediate impact on the level of FFN children) and FFN*PolicyTrend (the post-intervention change in FFN trend). Our estimated impacts are thus dependent upon model choice. While we generally select the more conservative approach (e.g. our selection of a 7-month intervention rather than an 11-month intervention), we use Model 1 estimates because that model has a much lower residual standard error than Model 2 (though a higher AIC). So it is possible we overestimate impacts by as much as 60 percent.

Table 4. Two Child Model Estimates

Model 1			Model 2		
	Coefficient	p-value		Coefficient	p-value
(Intercept)	7636.5	0.319	(Intercept)	24613.8	0.000
Time	411.4	0.008	Time	26.3	0.292
$Time^2$	-19.5	0.142	-	-	-
$Time^3$	-0.6	0.335	-	-	-
FFN	5376.6	0.000	FFN	6892.9	0.000
FFN*Time	-47.8	0.001	FFN*Time	-277.9	0.000
PolicyFeb17	2011.4	0.004	PolicyFeb17	1863.8	0.000
PolicyTrend	197.3	0.071	PolicyTrend	-492.6	0.000
FFN*Policy	-8067.7	0.000	FFN*Policy	-4968.1	0.000
FFN*PolicyTrend	-288.5	0.000	FFN*PolicyTrend	-172.8	0.003
1PctEmployment	0.4	0.002	X1PctEmployment	0.2	0.008
$R185Time^2$	67.1	0.055	$R185Time^2$	25.2	0.000
-	-	-	FFNAug18	-2336.6	0.000
-	-	-	FCCAug18	254.9	0.228
AIC 979			AIC 963		
Residual standard error: 485			Residual standard error: 904		
Degrees of freedom: 66 total; 54 residual			Degrees of freedom: 66 total; 54 residual		

Did CCAP Parents Substitute FCC Care for FFN Care?

Before estimating the policy impacts with a counterfactual FFN series, we consider why the model estimates suggest that FCC children (unlike FCC providers) increased over time and increased from the time of the intervention (possibly due to the intervention).

In Interrupted Time Series analysis with a comparison group, we assume that the comparison group (FCC children), can guide our understanding of how FFN children would have trended without the policy intervention. In particular we assume that FFC children were not affected by the intervention. In general we expect the post-intervention level and trend coefficients of the control group (PolicyFeb17 and PolicyTrend) to be zero, small or statistically insignificant, as in the provider estimates. Since the coefficients are significant and substantial (though contradictory), however, they threaten the analysis' validity. In this case, the rising FCC children series threatens the analysis' validity *unless it is independent of the policy intervention and picks up the net influence of confounding factors unrelated to the policy and not explicitly included in the model.* If they are independent of the intervention, the confounding factors can be accounted for in the impact estimate by passing them on to our estimate of the counterfactual time series of FFN children, as we do later. But do we have evidence that the FCC series is independent of the intervention?

One possibility of independence is that the recovery of participation in CCAP due to earlier eligibility restorations in November 2015 continued over the period of the study, and the positive coefficients of PolicyFeb17 and PolicyTrend pick up elements of this

recovery that are not modelled. This ongoing CCAP recovery would not challenge validity because it would affect all CCAP children, including those in FFN care. Another possibility is one that we tried to model with R185Time[2] – that the restoration of CCAP eligibility to 185 percent of the federal poverty level (from 162 percent) brought more people to CCAP after October 2017. That also would not challenge the validity of the analysis because it would also affect all types of care, including FFN care.

What might challenge the validity of the analysis is the possibility that a substantial number of children substituted FCC care for FFN care in CCAP because of the policy announcement. Because CCAP did not enforce the new training requirement, we did not model this hypothesis more rigorously. The basic data for individual children, however, do not support this interpretation. First, Table 5 shows the actual number of subsidized Illinois children in FFN care in February 2017 and their CCAP care one year later in February 2018. Fewer than 3 percent moved to FCC care. By far the larger number left CCAP, a churning phenomenon which is also not uncommon for FFN children, though not in these magnitudes. To illustrate this, the last two rows of data in Table 5 show the average percentages of movement from February cohorts in 2013 and 2016, the two previous undistorted years in CCAP -- See Appendix 5 – and the movements that would have taken place if those comparative percentages had applied in 2017-2018. The comparison shows that CCAP would have served about 2,250 more children in FFN care, about 2,000 fewer children would have left CCAP and about 275 fewer would have moved to licensed care in CCAP.

Table 5.

CCAP Children with FFN Providers in Feb. 2017: In What Type of Care Were They in Feb. 2018?						
	Total CCAP Children in FFN Care, February 2017	**Their CCAP Care in February 2018**				
		FFN	**Licensed Center**	**FCC**	**Exempt Center**	**No CCAP**
Children	37,362	17,509	1,096	1,041	122	17,594
2017-2018 Percent	100%	47%	3%	3%	0%	47%
Comparison Years, avg. 2013 & 2016 Percent	100%	53%	2.3%	2.8%	0.3%	42%
2017 Children with Comparison Years Percent	37,362	*19,766*	*846*	*1,062*	*120*	*15,567*
Source: Payment data for the Illinois Child Care Assistance Program, February 2013, 2014, 2016, 2017, 2018.						

Table 5 represents only one cohort of children in FFN care. Since it is also possible that new subsidy entrants who might have used FFN care used licensed care instead, we analyzed children entering CCAP in various types of care in the two years prior to the February 2017 policy announcement and two years after (Table 6). There were large decreases of entrants with FFN care in the two years following the announcement, but no apparent corresponding increase in children in FCC care. This suggests that children who would have used FFN care in CCAP simply did not participate in CCAP.

Table 6.

Children Newly Entering CCAP in Years before & after Health & Safety Training Policy Announcement								
	Center Care		FCC Care		FFN Care		Total	
New Entrants in	Number	Change	Number	Change	Number	Change	Number	Change
Mar. 2015 - Feb. 2016	15,803	-	6,067	-	6,520	-	28,204	-
Mar. 2016 - Feb. 2017	21,370	35%	7,852	29%	8,914	37%	37,890	34%
Mar. 2017 - Feb. 2018	21,033	-2%	7,833	0%	6,774	-24%	35,437	-6%
Mar. 2018 - Feb. 2019	20,926	-1%	7,696	-2%	5,891	-13%	34,380	-3%
Source: CCAP administrative data. A *"new" entrant* was defined as a child who had not had child care assistance for at least 6 months.								

Measuring Policy Impact – Constructing the Counterfactual FFN:

Assuming that our GLS regression model appropriately fits the data, we can fit a regression curve to the number of children in FFN in each month. These fitted regression values appear in Appendix 3, along with the fitted values for children in FCC care and in Figure 4 below. For each estimate we calculated 95 percent prediction intervals. As with the provider model, these prediction intervals conservatively reflect more uncertainty than narrower confidence intervals. The statistical package R, however, does not have tools available for calculating prediction intervals for generalized least squares (GLS) predictions. Consequently, we approximated a prediction interval by estimating an OLS version of our model, obtaining the interval ranges around the OLS predictions, and applied this range – *not the interval values* – to the GLS predictions. These are the 95 percent prediction intervals presented in Appendix 3 and in Figure 4. While we do not expect the predicted values obtained from GLS to be biased, there might be bias in the prediction interval *ranges* derived from OLS that we place around those predicted values.

We define the policy intervention's impact at any point in time as the difference between what the number of FFN children would have been in the absence of the intervention and the actual number of children in that month:

Policy impact on FFN Children ≡ FFN children without intervention – Actual FFN children

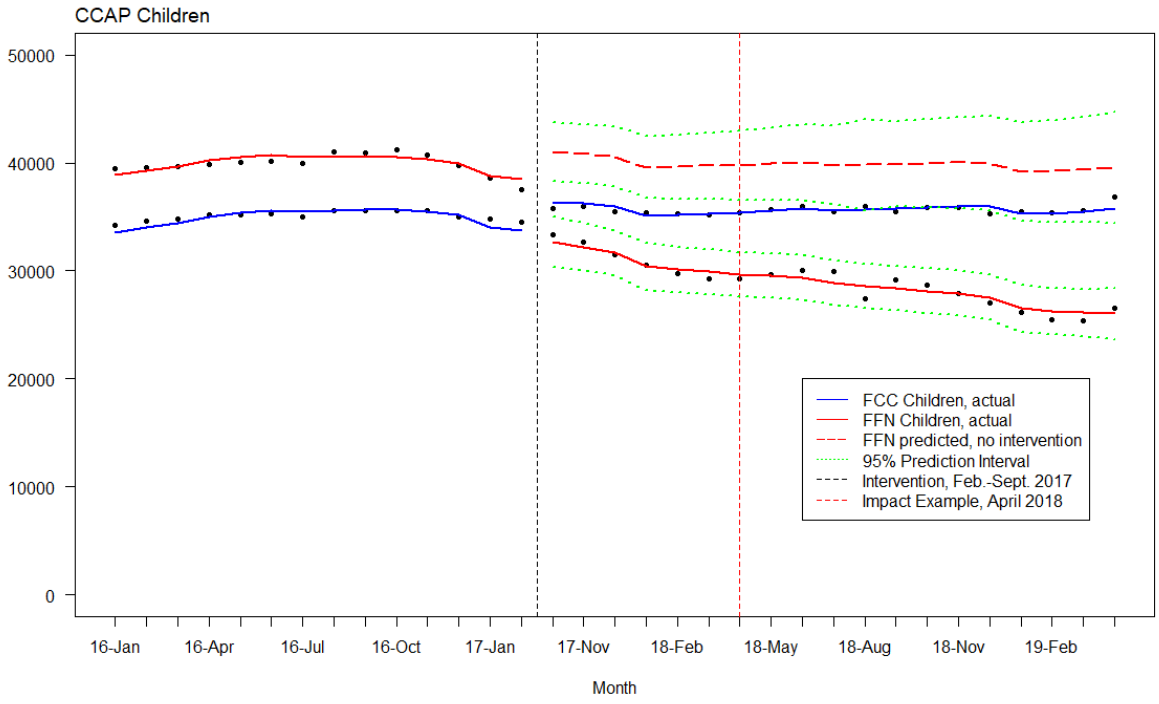
The number of FFN children in the absence of intervention is a counterfactual concept with unobservable values, and we must estimate its values for different points in time, as we do below. The actual number of FFN children has an observed value at different points in time, but for consistency we will use the estimated values provided by the fitted GLS regression. Thus for any point in time,

Estimated Policy impact on FFN Children ≡ Estimate of FFN children without intervention (counterfactual) minus the model-fitted estimate of FFN children.

Creating a counterfactual time series of children in FFN care. To estimate a counterfactual time series of FFN children, we re-estimate the model without the post-intervention FFN level and trend variables, FFN*Policy and FFN*PolicyTrend. The estimated counterfactual time series will (1) coincide with the pre-intervention factual time series of FFN children, but (2) gives a new post-intervention series of FFN children over time. The resultant time series of FFN children thus reflects pre-intervention FFN trends and post-intervention trends in the control group of FCC children, which by assumption the policy intervention does not affect.

Figure 4 shows the actual levels of children in FFN care (black dots along solid red line) and FCC care (black dots along solid blue line) during the study period, January 2016 through April 2019. The vertical dashed black line represents the 7-month policy intervention – from the February 2017 announcement of required health and safety training to October 1, 2017 when untrained providers would lose their payments. The trend in FCC children is our comparison group: it tells us how a group that is unaffected by the policy intervention trended. Since it is a similar group of children in a similar type of care, it indicates how FFN children would have trended without the intervention. The red and blue lines themselves are the fitted linear regression model. The green dotted lines are 95 percent prediction intervals around all of the estimates. [These indicate the range of values each month that are likely to contain the true number of CCAP children in FFN care 95 percent of the time, given the values of predictors that month.]

Figure 4. Children with Child Care Assistance in FFN & FCC homes, before and after health and safety policy phase-in (Feb. – Oct. 1, 2017).



The horizontal dashed red line from October 2017 to April 2019 is the counterfactual prediction of what the number of FFN children would have been without the policy intervention. As earlier, this counterfactual comes from two sets of information: the pre-intervention trend in FFN children and the post intervention changes in the unaffected comparison group of FCC children. The vertical distance between this dashed red line and the solid red line each month measures the impact of the announcement of the health and safety training mandate. Table 7 shows the cumulative impact in the first through the seventh month following the 7-month policy phase-in. The estimated impact in the first month (October 2017) was a loss of 8,356 children in subsidized FFN care, or 20 percent of the predicted October 2017 level. That is the sum of the coefficients of FFN*Policy and FFN*PolicyTrend (in month 1 following the intervention). Six months later in April 2018 (the vertical dotted red line), the cumulative impact was a loss of 10,088 children, or 25 percent of the predicted April 2018 level.

Table 7.

Estimated Impact of New Health & Safety Training Requirements on Children in FFN Care in CCAP (using policy phase-in period of February – October 1, 2017). Impact is relative to the predicted number of children in FFN care. This estimate controls for confounding factors. Reported impacts are cumulative to that month.

	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18
Children in FFN, Change	-8,356	-8,645	-8,933	-9,222	-9,510	-9,799	-10,088
% Change in FFN Children	-20%	-21%	-22%	-23%	-24%	-25%	-25%

Impacts by Race

In the CCAP program, children of three races (and multiracial children) make up almost all children whose race is known – that is, whose race was attributed by the parents: Black or African American, Latinx or Hispanic American, and White or European American. We estimated separate GLS models for children in each of these groups. Appendix 4 contains R code for these models and shows that some variation in handling the variables for time, the semi-wild point of August 2018, and the autocorrelation structure across these models improved the fit. The basic linear models employed show the variation in handling time and the August 2018 point:

$$\text{Black Children}_t = \beta_{0t} + \beta_{1t}\,\text{Time} + \beta_{2t}\,\text{Time}^3 + \beta_{3t}\,\text{FFN} + \beta_{4t}\,\text{FFN*Time} + \beta_{5t}\,\text{PolicyFeb17} + B_{6t}\,\text{PolicyTrend} + \beta_{7t}\,\text{FFN*Policy} + \beta_{8t}\,\text{FFN*PolicyTrend} + \beta_{9t}\,\text{1PctEmployment} + \beta_{10t}\,\text{R185Time}^2 + \epsilon_t$$

$$\text{Latinx Children}_t = \beta_{0t} + \beta_{1t}\,\text{Time} + \beta_{2t}\,\text{FCCAug18} + \beta_{3t}\,\text{FFNAug18} + \beta_{4t}\,\text{FFN} + \beta_{5t}\,\text{FFN*Time} + \beta_{6t}\,\text{PolicyFeb17} + \beta_{7t}\,\text{PolicyTrend} + \beta_{8t}\,\text{FFN*Policy} + \beta_{9t}\,\text{FFN*PolicyTrend} + \beta_{10t}\,\text{1PctEmployment} + \beta_{11t}\,\text{R185Time}^2 + \epsilon_t$$

$$\text{White Children}_t = \beta_{0t} + \beta_{1t}\,\text{Time} + \beta_{2t}\,\text{Time}^2 + \beta_{3t}\,\text{Time}^3 + \beta_{4t}\,\text{FFN} + \beta_{5t}\,\text{FFN*Time} + \beta_{6t}\,\text{PolicyFeb17} + \beta_{7t}\,\text{PolicyTrend} + \beta_{8t}\,\text{FFN*Policy} + \beta_{9t}\,\text{FFN*PolicyTrend} + \beta_{10t}\,\text{1PctEmployment} + \beta_{11t}\,\text{R185Time}^2 + \epsilon_t$$

The models were estimated with separate data sets for Black, Latinx and White children, and the variables are defined as described above for the provider and children models. The subscript t designates month. Results appear in Figures 5 through 7 and in Table 8.

As Figures 5 – 7 show, more Black children used FFN and FCC care in CCAP than either Latinx or White children. For all of these children, however, the numbers in FFN care dropped after the policy intervention and continued to fall for several months following the intervention. Moreover, we see that patterns of use differ by race:

- For most of the study period, more Black children used FFN care than FCC care. After intervention, Black children in FFN care dropped below those in FCC care.
- Fewer Latinx children used FFN care than FCC care throughout the study period.
- More White children used FFN care than FCC at the beginning of the study period, but this reversed even before the intervention.

Having higher participation in FFN care, Black children experienced larger losses following the intervention. Table 8 shows these. Black children made up 83 percent of total losses for these groups.

Figure 5. Black Children with Child Care Assistance in FFN & FCC homes, before and after health and safety policy phase-in (Feb. – Oct. 1, 2017)

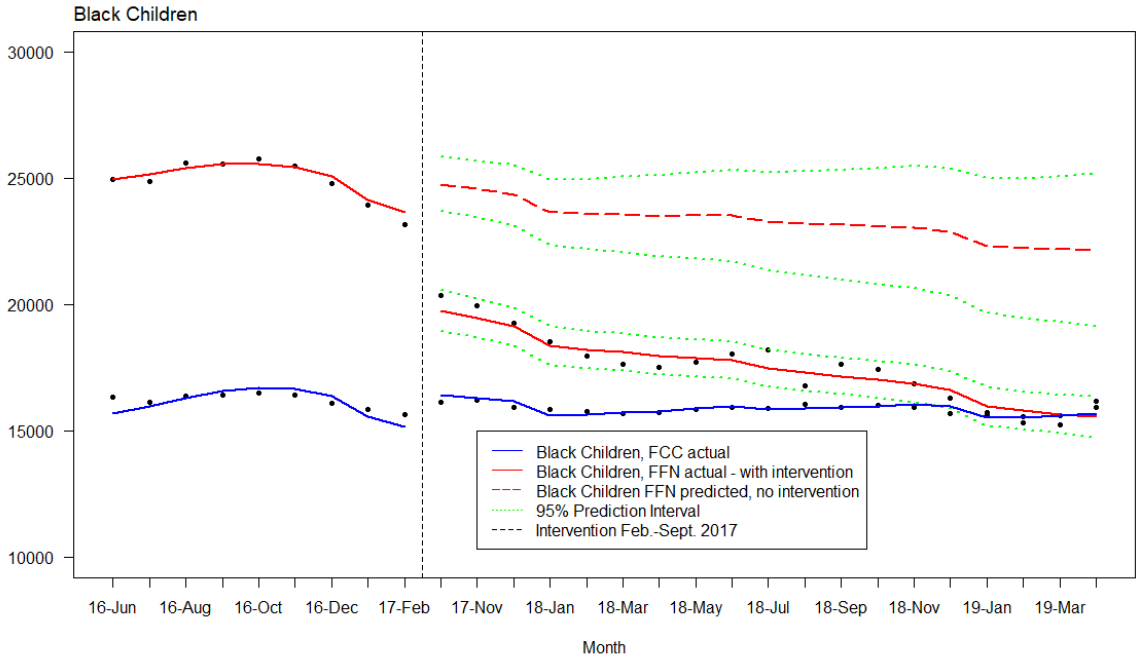


Figure 6. Latinx Children with Child Care Assistance in FFN & FCC homes, before and after health and safety policy phase-in (Feb. – Oct. 1, 2017)

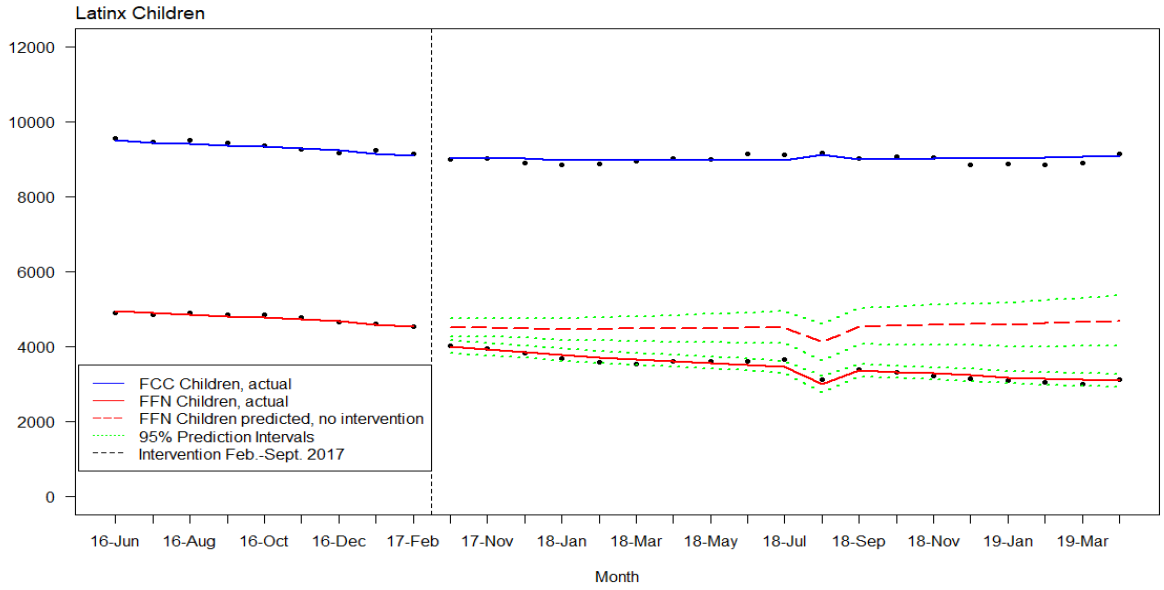


Figure 7. White Children with Child Care Assistance in FFN & FCC homes, before and after health and safety policy phase-in (Feb. – Oct. 1, 2017)

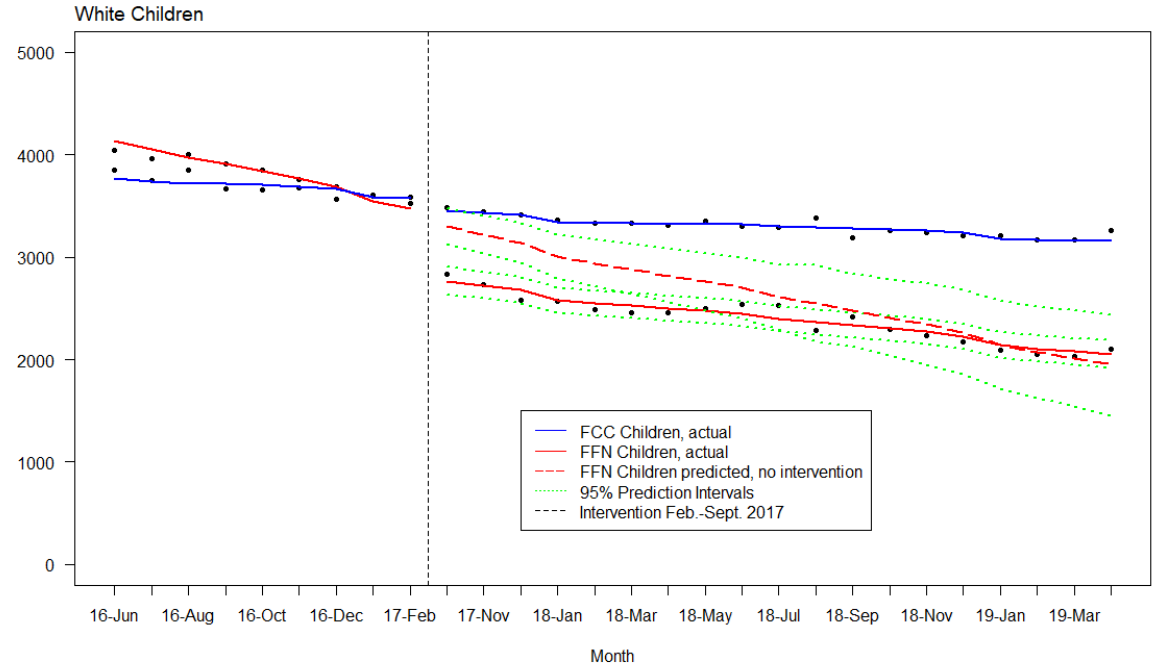


Table 8.

Impacts by Race of the Announcement of Health & Safety Training Requirements on CCAP Children in FFN Care, as of Policy Effective Date (Oct. 2017) and 6 Months Later (April 2018)

	October 2017		April 2018	
Group	Change in FFN Children	% Change in FFN Children	Change in FFN Children	% Change in FFN Children
Black Children	-5,016	-20%	-5,549	-24%
Latinx Children	-511	-11%	-874	-19%
White Children	-514	-15%	-389*	-13%*

Estimates of all impacts are from individual interrupted time series models for the three racial groups and are significant at a 95% confidence level. The child's race is ascribed by the parent. Models were not estimated for smaller groups of children: Asian and Pacific Islander Americans, Native Americans and Alaskans, multiracial, and of another or unknown race.
* This is for March 2018. In April 2018 and thereafter, the estimated impact for White children was not significant at a 95% level.

Discussion

Under appropriate conditions, interrupted time series has validity as a causal analysis. We identified some of the limitations in our design, data and methods above. Notable challenges include a relatively short time series from which seasonal patterns cannot be identified and addressed; some demographic differences between the intervention group (FFN children) and the comparison group (FCC children); and some ambiguity about the timing of the intervention period – whether it was 11 or 7 months (as we conservatively assumed). We made methodological decisions that seem to be appropriate, but alternatives could have been explored further. For example,

- The ARMA(4,4) structure of the monthly child data is a relatively unusual one, but we derived it from autocorrelation and partial autocorrelation plots and found that it fit better than others we explored. The ARMA(16,4) structure of the Latinx child data is also very unusual, but we selected this model for its fit.
- We could have tried to fit an autoregressive integrated moving average (ARIMA) model of the time series instead of estimating a GLS regression model with an ARMA specification, but typically the former requires having at least 50 data points, not 34.
- We could have explored racial impacts by estimating an integrated regression with dummy and interactive variables for race instead of fitting different regressions for Black, Latinx and White children. Again, our decision rule was parsimony in fit.

More generally, regression analysis always faces the threat of unknown confounding factors and misspecification. Factors such as falling population of young children and rising family incomes over our time period might have affected the FFN provider and children time series, but using data that are available only annually did not improve the model fit. We also reasoned that these factors should have affected FCC providers

and children, and shaped the counterfactual FFN series, in the same way they might have affected FFN providers and children.

Given such limitations, we would be wise to apply additional analysis to estimate these data (for example, difference-in-difference techniques); explore additional data (for example, two earlier rounds of regulating FFN providers in 2006 and 2011); and collect qualitative data from FFN providers and those who work with them on their experiences during this time.

In the meantime, setting aside our concern with limitations of this study, we can assert that the evidence allows us to reject the null hypothesis that there was no connection between the announcement of new health and safety training requirements for FFN providers in 2017 and the subsequent decline in the numbers of FFN providers and children. In fact, we have strong grounds for causal inference. We adjusted the pre-intervention trends in FFN providers and children for the post-intervention trends of FCC providers and children, our comparison groups, and still measured a significant impact of the announcement on trends in FFN providers and children in their care.

These impacts were not intentional inasmuch as the goal of the policy announcement was to improve the quality of FFN child care, not to reduce numbers, particularly Black children and their FFN providers. The losses of large numbers of providers and children in FFN care reflect an unintentionally inequitable policy.

Appendix 1. License-exempt home-based child care and health and safety training

License-exempt home-based child care, also known as *family, friend and neighbor child care* (FFN care), is legal care in Illinois in the unlicensed home of the provider or the child's home. Illinois is one of the relatively few states historically to extend the federal principle of parental choice to including FFN care as a major part of its Child Care Assistance (subsidy) Program (CCAP). In CCAP, where the plurality of subsidized children were in FFN care as recently as 2010, FFN providers are paid far less than licensed providers: during the period 2016 – 2017, just $16.22 per child for a full day (or about $2 per hour) compared to a rate as high as $35.30 for a licensed home provider caring for a toddler.[9] Illinois limits the number of children allowed in a FFN care setting to no more than three if the children are not related.

The new training requirements announced in February 2017 required that FFN providers complete a series of health and safety trainings by October 2017 in order to receive future CCAP payments and that any FFN provider new to CCAP had to complete the requirements before they could receive CCAP reimbursement. As originally announced, the new preservice health and safety training policy required 16 to 21 training hours, depending upon whether the training was taken in person or online. Trainings included:

- Illinois' ECE Credential Level 1, Tier 1 (8-12 hours)
- CPR/First Aid Training (5 hours, in person only)
- Child Abuse and Neglect / Mandated Reporter Training (1-2 hours)
- "What is CCAP?" (2 hours)

Providers who completed these requirements received a 10 percent CCAP reimbursement add-on. They could voluntarily complete the second and third tiers of the ECE credential to receive 15% or 20% rate add-ons, respectively. In Illinois, the training requirements were more rigorous than required in the 2014 federal reauthorization of the Child Care Development Block Grant.

While the policy was never enforced in its original specification and CCAP eventually exempted all relative providers, the announced policy was widely promulgated, including in official letters to CCAP providers.[10] In response, many FFN providers may have lacked the skills, equipment or internet access to take prescribed online trainings. Also, in order to register and complete some of the tasks, providers had to log on to the state's Gateways provider registry, a process which presented technical challenges to some.

Beginning in April 2017, the requirements and deadlines changed several times, potentially confusing providers. In September 2018, a shorter 11- to 13-hour set of requirements was introduced (without an add-on) which allowed providers to complete a shorter "Health and Safety Basics" training in place of the ECE Level 1 Tier 1.

[9] Illinois Department of Human Services CCAP rate schedule: https://www.dhs.state.il.us/page.aspx?item=75772

[10] We cannot be sure when FFN providers first heard of the new policy announcement. An official letter announcing the policy was mailed in February 2017 and a revised policy was sent in April 2017. At one time the state's *Illinois Child Care Plan* dated the policy effective November 2016, three months prior to the February letter. Child Care Resource and Referral agencies' staff may have begun to notify providers prior to the February mailing. Because it is unclear when most providers learned of the new policy, our study explored two policy phase-in periods, seven months (beginning February 2017) and 11 months (beginning November 2016 and matching a turning point in the trend of children in FFN care). The estimates of the policy impact are similar.

Appendix 2. Predicted CCAP Providers, Model 1 – FFN, counterfactual FFN, & FCC, with 95% prediction intervals.

The post Intervention impact is FFN (actual) minus FFN (counterfactual).

	FFN actual & fitted	Lower PI	Upper PI	Counterfactual FFN (without Intervention)	Lower PI	Upper PI	FCC actual & fitted	Lower PI	Upper PI
Jan-16	**18,043**			**18,043**			**5,070**		
Feb-16	**18,068**			**18,068**			**5,076**		
Mar-16	**18,097**			**18,097**			**5,039**		
Apr-16	**18,198**			**18,198**			**5,036**		
May-16	**18,138**			**18,138**			**5,020**		
Jun-16	**18,070**			**18,070**			**4,978**		
Jul-16	**17,923**			**17,923**			**4,930**		
Aug-16	**18,352**			**18,352**			**4,972**		
Sep-16	**18,321**			**18,321**			**4,903**		
Oct-16	**18,531**			**18,531**			**4,877**		
Nov-16	**18,318**			**18,318**			**4,872**		
Dec-16	**17,895**			**17,895**			**4,814**		
Jan-17	**17,422**			**17,422**			**4,796**		
Feb-17	**16,945**			**16,945**			**4,778**		
Oct-17	**14,497**	14,010	14,999	**17,485**	16,647	18,344	**4,701**	4,435	4,977
Nov-17	**14,258**	13,814	14,717	**17,437**	16,539	18,283	**4,676**	4,422	4,931
Dec-17	**13,977**	13,519	14,437	**17,331**	16,459	18,262	**4,636**	4,385	4,891
Jan-18	**13,334**	12,898	13,778	**16,764**	15,889	17,710	**4,473**	4,235	4,723
Feb-18	**13,186**	12,754	13,620	**16,810**	15,850	17,733	**4,473**	4,224	4,715
Mar-18	**13,091**	12,676	13,530	**16,921**	15,931	17,926	**4,491**	4,244	4,739
Apr-18	**12,943**	12,525	13,374	**16,963**	15,971	17,961	**4,491**	4,252	4,737
May-18	**12,882**	12,449	13,278	**17,118**	16,051	18,280	**4,521**	4,276	4,759
Jun-18	**12,771**	12,373	13,219	**17,208**	16,083	18,414	**4,533**	4,292	4,784
Jul-18	**12,505**	12,099	12,912	**17,083**	15,883	18,307	**4,488**	4,261	4,727
Aug-18	**12,364**	11,974	12,792	**17,126**	15,934	18,397	**4,488**	4,243	4,737
Sep-18	**12,238**	11,838	12,622	**17,188**	15,927	18,498	**4,493**	4,257	4,731
Oct-18	**12,115**	11,694	12,547	**17,253**	15,936	18,713	**4,498**	4,260	4,728
Nov-18	**12,010**	11,617	12,435	**17,342**	15,970	18,833	**4,510**	4,257	4,778
Dec-18	**11,826**	11,430	12,227	**17,314**	15,853	18,854	**4,491**	4,254	4,741
Jan-19	**11,370**	10,944	11,779	**16,878**	15,369	18,433	**4,367**	4,122	4,621
Feb-19	**11,262**	10,825	11,661	**16,951**	15,376	18,605	**4,374**	4,120	4,622
Mar-19	**11,206**	10,772	11,606	**17,101**	15,480	18,835	**4,402**	4,147	4,669
Apr-19	**11,168**	10,750	11,614	**17,281**	15,563	19,185	**4,437**	4,174	4,701

Appendix 3. Predicted CCAP Children – FFN, counterfactual FFN, and FCC, with 95% prediction intervals.

The post Intervention impact is FFN (actual) minus FFN (counterfactual).

	FFN actual & fitted	Lower PI	Upper PI	Counterfactual FFN (without Intervention)	Lower PI	Upper PI	FCC actual & fitted	Lower PI	Upper PI
Jan-16	**39,491**			**39,491**			**34,260**		
Feb-16	**39,551**			**39,551**			**34,578**		
Mar-16	**39,626**			**39,626**			**34,843**		
Apr-16	**39,886**			**39,886**			**35,162**		
May-16	**40,106**			**40,106**			**35,234**		
Jun-16	**40,137**			**40,137**			**35,301**		
Jul-16	**39,954**			**39,954**			**34,962**		
Aug-16	**41,054**			**41,054**			**35,584**		
Sep-16	**40,918**			**40,918**			**35,546**		
Oct-16	**41,213**			**41,213**			**35,623**		
Nov-16	**40,785**			**40,785**			**35,597**		
Dec-16	**39,759**			**39,759**			**34,961**		
Jan-17	**38,651**			**38,651**			**34,809**		
Feb-17	**37,549**			**37,549**			**34,543**		
Oct-17	**32,662**	31,485	33,840	**41,019**	39,595	42,443	**36,359**	35,182	37,537
Nov-17	**32,196**	31,083	33,310	**40,841**	39,419	42,263	**36,230**	35,116	37,343
Dec-17	**31,655**	30,568	32,742	**40,589**	39,131	42,046	**36,025**	34,938	37,112
Jan-18	**30,398**	29,295	31,501	**39,620**	38,092	41,148	**35,104**	34,001	36,207
Feb-18	**30,114**	29,034	31,195	**39,625**	38,050	41,200	**35,156**	34,076	36,237
Mar-18	**29,943**	28,880	31,007	**39,742**	38,112	41,372	**35,322**	34,258	36,386
Apr-18	**29,670**	28,613	30,727	**39,757**	38,062	41,453	**35,385**	34,327	36,442
May-18	**29,578**	28,521	30,635	**39,954**	38,188	41,721	**35,629**	34,572	36,687
Jun-18	**29,386**	28,326	30,445	**40,050**	38,209	41,892	**35,773**	34,714	36,833
Jul-18	**28,862**	27,817	29,908	**39,816**	37,907	41,725	**35,586**	34,541	36,632
Aug-18	**28,600**	27,553	29,647	**39,842**	37,855	41,829	**35,660**	34,613	36,707
Sep-18	**28,367**	27,315	29,419	**39,897**	37,829	41,965	**35,763**	34,711	36,815
Oct-18	**28,134**	27,075	29,192	**39,953**	37,801	42,104	**35,867**	34,808	36,925
Nov-18	**27,932**	26,865	29,000	**40,040**	37,804	42,276	**36,002**	34,934	37,069
Dec-18	**27,545**	26,477	28,612	**39,941**	37,623	42,258	**35,950**	34,883	37,018
Jan-19	**26,510**	25,399	27,621	**39,195**	36,775	41,614	**35,252**	34,141	36,363
Feb-19	**26,262**	25,164	27,360	**39,235**	36,738	41,732	**35,340**	34,243	36,438
Mar-19	**26,125**	25,018	27,232	**39,387**	36,803	41,971	**35,540**	34,433	36,647
Apr-19	26,019	24,821	27,218	**39,569**	36,862	42,277	**35,770**	34,572	36,969

Appendix 4. Provider and Child models written in R code.

ProviderModel <- glm(Providers ~ Time + $Time^3$ + FFN + FFN*Time + PolicyFeb17 + PolicyTrend + FFN*Policy + FFN*PolicyTrend + X1PctEmpl + $R185Time^2$, family = quasipoisson(link = "log"), data = data)

ChildrenModel <- gls(Children ~ Time + $Time^2$ + $Time^3$ + FFN + FFN*Time + PolicyFeb17 + PolicyTrend + FFN*Policy + FFN*PolicyTrend + 1PctEmployment + $R185Time^2$, data=data, correlation=corARMA(p= 4, q = 4), method = "ML")

Models for Children by Race:

BlackChildrenModel <- gls(Children ~ Time + $Time^2$ + $Time^3$ + FFN + FFN*Time + PolicyFeb17 + PolicyTrend + FFN*Policy + FFN*PolicyTrend + 1PctEmployment + $R185Time^2$, data=data, correlation=corARMA(p= 4, q = 4), method = "ML")

LatinxChildrenModel <- gls(Children ~ Time + FFN + FFN*Time + PolicyFeb17 + PolicyTrend + FFN*Policy + FFN*PolicyTrend + 1PctEmployment + $R185Time^2$+ FFNAug18 + FCCAug18 , data = data, correlation=corARMA(p = 16, q=4), method = "ML")

WhiteChildrenModel <- gls(Children ~ Time + $Time^3$ + FFN + FFN*Time + PolicyFeb17 + PolicyTrend + FFN*Policy + FFN*PolicyTrend + 1PctEmployment + $R185Time^2$, data=data, correlation=corARMA(p= 4, q = 4), method = "ML")

Appendix 5. Comparing February Cohorts of FFN Children in CCAP over the Next Year

The two last data rows of Table 5 compare the movements of the February 2017 cohort of subsidized children in FFN care to similar movements in February cohorts before the 2017 policy intervention that announced health and safety training requirements for FFN providers in the Illinois child care subsidy program. Table A5 shows those pre-intervention February cohorts – 2013 and 2016. The last three data rows of Table A5 show the counterfactual experiment of applying the average movements of the 2013 and 1016 cohorts to the February 2017 cohort.

The results are suggestive for the 2017 cohort: without the intervention, thousands fewer children would have left CCAP and thousands more would have remained in CCAP with FFN care, while a similarly small number would move to licensed care. Although "churn" is common among subsidized FFN children, the post-intervention churn of the February 2017 cohort was uncommonly large by this comparison.

Table A5. Comparing the Average Pre-Intervention CCAP Churn to the 2017 Cohort's Churn

Cohort	CCAP Children in FFN	Their CCAP Care in February of Next Year				
		FFN	Licensed Center	FCC	Exempt Center	No CCAP
Feb. 2013	53,735	28,142	1,242	1,538	196	22,617
	100%	52%	2%	3%	0%	42%
Feb. 2014	54,033	34,266	1,119	1,549	197	16,902
	100%	63%	2%	3%	0%	31%
Feb. 2016	39,376	21,117	867	1,109	104	16,179
	100%	54%	2%	3%	0%	41%
Feb. 2017	37,362	17,509	1,041	1,096	122	17,594
	100%	47%	3%	3%	0%	47%
Estimate of FFN Children in CCAP, 2017-18 without intervention		FFN	Licensed Center	FCC	Exempt Center	No CCAP
Feb. 2013 + Feb. 2016	93,111	49,259	2,109	2,647	300	38,796
	100%	52.9%	2.3%	2.8%	0.3%	41.7%
Feb. 2017 Cohort with 2013 & 2016 percentages:						
Feb. 2017	37,362	19,766	846	1,062	120	15,567
Source: Illinois Child Care Assistance payment files.						

In selecting pre-intervention February cohorts for our average, we excluded 2014 and 2015. Subsidy policies justify this. The February 2014 cohort received an unusual automatic subsidy

renewal, and as shown in Table A5, substantially more FFN children remained in the subsidy program (63% vs. 52% in the "FFN" column of Table A5) because of the automatic renewal. Averaging in this percentage would make the 2017 cohort exits even larger by comparison than they probably were. We omitted them to produce a more conservative illustration.

On the other hand, the 2015 cohort (not shown in Table A5) was subject to very large emergency cuts in eligibility, cuts that prevented FFN children from returning if they temporarily left the subsidy – which is another common aspect of the churn. Averaging in these temporary exclusions would artificially inflate the "No CCAP" column in Table A5. Thus in constructing an average churn, then, we excluded both the 2014 and 2015 cohorts as atypical years.