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Abstract:
Persistently high workload may raise sickness absence with associated costs to firms and society. We proxy workload by the number of adults per child in Norwegian child care centers, but do not find that centers with many adults per child have lower sickness absence than other centers. However, we do find that more college-educated teachers per child are associated with lower sickness absence, whereas more assistants (with low or no education) per child are associated with higher sickness absence, suggesting that the observed variation in sickness absence at the center level is mainly driven by compositional differences of the employees rather than workload. The importance of compositional effects is supported by findings from individual fixed effects models and a regression discontinuity approach relying on results from municipal elections.

Keywords: Workload, sickness absence, child care centers, teachers per child, education level

JEL classification: I1, I2

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Sammendrag

Vedvarende høy arbeidsbelastning kan øke sykefraværet med tilhørende kostnader for bedrifter og samfunn. Vi måler arbeidsbelastning basert på antall voksne per barn, men finner ikke at barnehager med mange voksne per barn har lavere sykefravær enn andre barnehager. Vi finner imidlertid at flere utdannede lærere per barn er forbundet med lavere sykefravær, mens flere assistenter (med lav eller ingen utdanning) per barn er forbundet med høyere sykefravær, noe som tyder på at den observerte variasjonen i sykefravær hovedsakelig er drevet av ulik sammensetning av ansatte i stedet for arbeidsbelastning. Den relativt sterkere betydningen av sammensetningseffekter i forhold til effekter av arbeidsbelastning, støttes av funn fra modeller med individ-faste effekter og en regresjonsdiskontinuitetsmetode som bygger på resultater fra kommunalvalg.

1 Introduction

Sickness absence is a substantial cost to society. On a typical working day, around 7 percent of Norwegian employees are absent from work due to sickness and the associated insurance payments amount to about 2.4 percent of Norwegian GDP (Markussen et al., 2011). Comparable numbers from OECD from 2015 suggest that days lost to sickness in Norway is high compared to the US, at 15 vs. about 4 days, similar to Sweden, where it is about 12, and lower than in Germany, where 18 days on average are lost to sickness during the year.[1] Moreover, the level of sickness absence varies substantially across groups; for example, it is much higher among high-school drop-outs than college graduates (e.g. Cutler and Lleras-Muney, 2010; Kostøl and Telle, 2011).

Workplace conditions have been shown to be an important risk factor for sickness absence (Labriola et al., 2006; Eriksen et al., 2016), but there is little evidence on possible effects of various indicators of workload (Bratberg et al., 2017; Gørtz and Andersson, 2014; Conen et al., 2012; Defebvre, 2018). To explore the relationship between workload and sickness absence, we use the number of adults per child as a proxy for workload and investigate the role of workload on sickness absence among employees in Norwegian child care centers. However, in addition to the number of adults per child, the centers also differ in terms of the composition of employees. For example, employees in child care centers in Norway include both college educated teachers and assistants with no or limited higher education. A number of studies have documented that health status correlates strongly with education, and some evidence suggests a causal link (Cutler and Lleras-Muney, 2010; Clark and Royer, 2013; Gathmann et al., 2015; Brunello et al., 2016). We will hence pay careful attention to the educational composition of the employees, noting that even if more adults were randomly assigned across centers, a causal effect on sickness absence of more adults *at the center level* could be driven by both lower workload and changes in the composition of adults with inherently low (teachers) or high (assistants) sickness absence. Distinguishing between effects on sickness absence from changes in adults per child versus in the composition of adults is crucial for our understanding of determinants of sickness absence

[1] OECD stats, see http://stats.oecd.org/index.aspx?queryid=30123

as well as for the design of policies to combat detrimental work conditions and promoting child development.

We start by exploring the association between the number of adults per child and sickness absence in all Norwegian child care centers 2007-2014. Then we investigate compositional effects, that is, how the association varies across centers with more teachers vs. assistants. Findings from such naive OLS models show that more adults per child are not associated with lower sickness absence. However, more teachers per child are associated with lower sickness absence, while more assistants per child are associated with higher sickness absence. This underlines the crucial need to account for compositional changes when measuring sickness absence at the institutional level.

To try to get closer to a causal estimate of the effect of more adults on sickness absence, we first rely on variation over time in fixed effects models. When adding municipality fixed effects in the OLS model, the significant negative association between teachers per child and sickness absence, and the significant positive association between assistants per child and sickness absence remain.

In a model with individual fixed effects, that is, when an individual's time-invariant characteristics like education and health are accounted for, the negative and statistically significant association between the number of teachers per child and sickness absence disappears. However, the positive association between assistants per child remains statistically significant. It is hard to see how more assistants *per se* could causally increase sickness absence. We may thus take this to suggest that more assistants are associated with some contemporaneous events that are detrimental to sickness absence. Such events could be more demanding children, not being fully compensated for by the additional assistants, or preceding higher sickness absence of the staff leading to more assistants being hired (i.e. reverse causality). Such endogeneity issues challenge the reliability of the applied model.

To try to address endogeneity problems, we apply a regression discontinuity approach. In a similar vein as several previous studies (Fiva et al., 2016; Pettersson-Lidbom, 2008; Ferreira and Gyourko, 2009), we take advantage of the fact that non-right political parties tend to increase the funding for the child care sector, and in particular to promote the hiring of teachers. Applying the regression discontinuity design (RDD) on a sample of municipalities where the non-right party block is close to the 50 percent cut-off at municipal elections, we find that non-right local governments result in somewhat lower sickness absence in the child care centers. We also estimate the associated local average treatment effect (LATE) by instrumenting the number of teachers per child by the election RDD.

A recent paper employing Danish data also explores sickness absence in child care centers to investigate the role of workload. Gørtz and Andersson (2014) study how the number of adults (per child) influences sickness absence in Danish child care institutions. Using 1-year lagged levels of the number of adults per child as an instrument, and including controls for individual teacher characteristics, workplace characteristics and background characteristics of the children, they find little evidence that more adults per child reduce sickness absence. We contribute to this literature along two dimensions: First, while Gørtz and Andersson (2014) look at all adults in centers, we emphasize how sickness absence is heterogeneous across educated teachers and assistants with no or limited higher education, and thus how changes in the educational composition of the employees at the center level affect interpretations. Second, we have a longer panel than Gørtz and Andersson (2014), allowing us to rely on variation over time in fixed effects models, and we extend the fixed effects analysis by implementing an instrumental variable approach to further illustrate possible causal effects of workload on sickness absence.

The remainder of the paper is organized as follows: Section 2 presents the Norwegian welfare system covering sickness absence benefits and the Norwegian child care system. Section 3 describes the empirical strategy. We present the data along with some descriptive statistics in Section 4. Section 5 presents our results, whereas Section 6 concludes.

2 Institutional setting

Sickness absence benefits

Sickness absence benefits are provided by the Norwegian National Insurance (NNI) program. The program covers all residents in Norway and participation is mandatory. Paid sickness absence is provided from day one of sickness and up to a maximum of one year. The coverage is 100 percent up to an established limit (about NOK 550,000 in 2016, i.e. about €60,000). Eligibility is determined by being employed for more than four weeks. If an employee reports absence due to sickness, the employer finances the first 16 days. After this, the

NNI program covers expenses. Firing employees due to sickness absence are prohibited by law. After three days (sometimes seven) the employee needs a certificate from a medical doctor to document illness in order to continue to receive sickness absence benefits.

Child care centers in Norway

Child care centers are part of the education system in Norway, although enrollment is voluntary (Drange and Havnes, 2018). Since September 1st, 2009 parents have legal rights to a slot in a child care center in their municipality of residence from August the year the child turns one.[2] Child care centers are financed by the municipality from local tax income and from central government transfers. This implies that the elected local council in each municipality decides on the allocation of funds to the child care sector. Private centers are entitled to the same transfer as the municipal centers, as long as they meet the quality requirements elaborated on below. Parental co-payment has been capped at a maximum level since 2003, amounting to around NOK 2,500 (about €275) per month for a full-time slot.

Quality is regulated with provisions on staff qualifications, the number of children per teacher, the size of the play area, etc. There is a nation-wide regulation stating that teachers per child should be no smaller than 1/9 for the group of toddlers 1-2, and 1/16 for the group of children aged 3-5. If the child care center is not able to recruit as many educated teachers as required, it may apply for an exemption. If granted, the teacher position may be held by an employee without the formal qualifications. Additional regulations on staffing are decided at the municipality level, but each teacher typically works with two assistants. There are no educational requirements for the assistants. The child care teacher education is a three-year college degree, and include supervised practice in a formal child care institution.

Child care centers are to some extent compensated with more support or staff when more demanding children enroll.

[2] If the child is born in September-December, the child does not have a right to a slot until August the year when the child turns 2, although many children enroll earlier.

3 Empirical strategy

Regression models

We start by exploring the association between the number of adults per child and sickness absence among employees in child care centers. We estimate the following linear probability model using OLS:

$$y_{ijt} = \alpha_0 + \alpha_1 \Pi_{jt} + \alpha_2 X_{it} + d_t + \varepsilon_{ijt} \tag{1}$$

The dependent variable y_{ijt} is a dummy that takes the value 1 if employee i in child care center j has a sickness absence spell in year t; or zero otherwise. α_0 is an intercept, whereas Π_{jt} represents the number of adults per child in the child care center. We will lag this variable by a year to allow for some time for the change in the number of adults per child to affect sickness absence.[3] X_{it} represents individual characteristics of employee i. d_t are year dummies, accounting for general variation in sickness due to e.g. business cycles (Haaland and Telle, 2015). ε_{ijt} is an error term with expectation zero allowing for correlation within municipality. Our parameter of interest is α_1, which captures the correlation (contingent on X_{it} and d_t) between the number of employees per child and sickness absence.

In addition to studying adults per child at the child center level, we will also consider teachers and assistants per child separately. This will illustrate how the educational composition of employees in child care centers may affect sickness absence and could be important if sickness absence varies substantially across teachers and assistants. This may give us a better understanding of whether it is the number of adults that matter, i.e. work pressure, or if the composition of staff, i.e. the number of teachers relative to the number of assistants, is more important for the association between sick absence at the institutional level.

It is well known that both individual characteristics and characteristics of the workplace are closely associated with sickness absence (Labriola et al., 2006; Markussen et al., 2011). As discussed in Section 2, child care centers are funded by the municipality, which also has some discretion on how to set and supervise standards of teachers, buildings and curricula, and on how to organize child care centers and allocate children to them. The choices and characteristics of the municipality may thus be important determinants of the workplace of

[3] Results are similar if we do not lag employees per child.

the child care center staff. To account for time-invariant observable and non-observable municipality characteristics, we will include municipality fixed effects in some specifications. We will consider adults, teachers, and assistants per child separately.

Individual characteristics are also important predictors of sickness absence. We account for several well-known observable determinants of sickness absence in X_{it}, but time-invariant unobservable characteristics may also be important. We will thus present a model that accounts for individual fixed effects as well. Note that time-invariant observable characteristics such as education level are accounted for in these regressions, hence compositional effects by education (as the ratio is at the center level) will be netted out. Again, we will consider adults, teachers, and assistants per child separately.

Fixed effects models would yield biased estimates of the causal effect of adults per child on sickness absence if the variation over time in adults per child is driven by contemporaneous variation in an omitted determinant of sickness absence. For example, if the center learns that it will receive more demanding children in the future, it may respond by hiring more assistants. Unless the additional assistants cannot fully compensate for the more demanding children, such dynamics will erroneously show that more assistants increase the sickness absence. A similar bias will occur if a center experiences or foresees higher sickness absence, and responds by hiring more assistants or teachers. To try to account for such endogeneity, and thus get closer to reliable causal estimates, we will apply an instrumental variable approach.

Instrumental variable approach

There is a burgeoning literature on how political parties in power at the local level shape political outcomes, and notably public spending (Pettersson-Lidbom, 2008; Ferreira and Gyourko, 2009; Fiva et al., 2016). Evidence from Norway suggests that non-right parties increase spending on child care and education (Fiva et al., 2016). In the studied period, these parties have increasingly been promoting more teachers per child, and hence a rise in the share of teachers among the adults in child care centers. The instrumental variable approach starts by investigating whether the political block in power impacts the number of teachers per child. There are 424 municipalities in Norway in the period studied, and for each municipality at every election (every fourth year) in our data window, we can identify the change in the electoral support of the non-right parties. We estimate the following first stage regression discontinuity design (RDD) specification:

$$\Pi_{ijkt} = \psi_0 + \psi_1 T_{kt} + \psi_2 X_{it} + d_t + v_{ijkt} \tag{2}$$

where T_{kt} is a treatment indicator taking the value 1 if the local government k is ruled by a non-right party constellation (i.e. holds the majority of the seats in the municipal council) in year t and zero otherwise. Note that there are usually several child care centers in one municipality. The parameter of interest, ψ_1, measures how the majority of the council affects teachers per child. v_{ijkt} is an error term with expectation zero allowing for correlation within the municipality. RDDs can be viewed as local randomized experiments with local points at right around the cutoff point. The idea behind this estimation strategy is that municipalities on the margin of obtaining a right or a non-right majority are similar, except that a non-right majority allocates discontinuously more resources to child care centers and in particular increases the number of teachers per child. We will estimate at varying bandwidths around the discontinuity of 50 percent (as shown in Eq. (2)). In addition, we will show results from a non-parametric local linear regression approach. Analogously to Eq. (1), the second stage model reads (estimated by 2SLS linear probability):

$$y_{ijkt} = \gamma_0 + \gamma_1 \hat{\Pi}_{ijkt} + \gamma_2 X_{it} + d_t + e_{ijkt} \tag{3}$$

where the notation is analogous to Eq. (1). The measure of teachers per child, $\hat{\Pi}_{ijkt}$, is now estimated with exogenous variation from the RDD in Eq. (2). The local average treatment effect (LATE) of teachers per child on sickness absence (y) is captured by the coefficient γ_1. The main identifying assumption is that the winning of the non-right block affects sickness absence solely through more teachers per child. However, the non-right block may also be more eager to enforce general rights of employees or more resources (in addition to more teachers) to child care centers in the municipality. To the extent that such rights or resources affect sickness absence, our instrumental variable approach may erroneously attribute impacts of such means (on sickness absence) to the effect of a higher teacher per child ratio. This constitutes a possibility that our estimate is upward biased. Since it is not fully transparent how these threats to the exclusion restriction may affect our estimates, we will also provide and discuss reduced form estimates.

4 Data

We use register data from Statistics Norway covering all employees in child care centers during the years 2007-2014. In addition to a unique institution identifier available in all registers in Norway, we have information on employees' age, gender, tenure, education (level and field) and sickness absence. We also use the child care center register, and from this register, we collect the total number of children enrolled in each child care center in each year as well as the number of children in each age group 1-5. The register does not contain individual information about the children enrolled. Based on these two registers we calculate the number of adults, teachers, and assistants per child at the center level. Teachers include all employees with a college degree in teaching or pedagogy, while we categorize all other employees as assistants.

Included in the sample are employees that work in child care centers more than 30 hours a week (i.e. full time). 90 percent of the teachers and 65 percent of the assistants work full time.[4] Our sample includes 80,790 employees in 3,904 child care centers.[5] On average each child care center has 21 employees, of which 13 are employed full-time, and 52 children. On average, 34 children are three years old or above and 18 are below the age of three.

We consider three ratios to proxy for workload: the number of adults, teachers, and assistants per child. These three ratios are calculated at the center level. Whereas the first ratio proxies the overall workload in a child care center, the inclusion of the two latter ratios enables us to study composition effects among the staff. On average there are about 2.5 adults for every 10 children, where 1 is a teacher and 1.5 are assistants.

Our outcome variable on sickness absence is constructed as a dummy that captures whether an employee has been certified as sick by a medical doctor during a calendar year. Sickness absence spells shorter than 3 days (sometimes 7 days) are often not certified by a doctor and thus not included in our data. Our main estimated sample is thus on the employee-level, and we allow employees to exit and enter over the covered years 2007-2014.

In many of the regressions we will, in addition to calendar year dummies, include a set of control variables (cf. X in Eqs. (1), (2) and (3)), including (unless otherwise noted) age (categorically), gender (dummy) and

[4]Our estimated results remain very similar if we also include those working less than full time.

[5]Family-driven child care centers are not included in the sample. These centers are very small, and often do not have independent organization identifiers, which makes it hard to link employees to centers.

center-specific tenure (first and second order polynomials). To account for varying workload related to the age of the child (cf. the regulation that there should be more teachers and adults per child if the child is below 3 years old), we also include a variable capturing the share of children in the center aged below 3.

Table 1: Summary statistics

Average age	39.8
Average years of tenure	4.3
Female share of employees	0.92
Share with a teacher degree	0.36
Share with sickness absence per year	0.32
Average number of sick days per year	21.00
Average adults per child ratio	0.24
Average teachers per child ratio	0.09
Average assistants per child ratio	0.15

Table 1 displays summary statistics. We see that the average age of an employee in a child care center is about 40 years old. Employees have on average 4.3 years of tenure in a particular center. Child care centers are primarily staffed by women, with a share above 90 percent. On average, as expected, 36 percent of the staff has a teacher or child care teacher degree from college. On average 32 percent of the adults have at least one sickness spell per year.[6] The average number of sick days per individual per year is 21.

5 Results

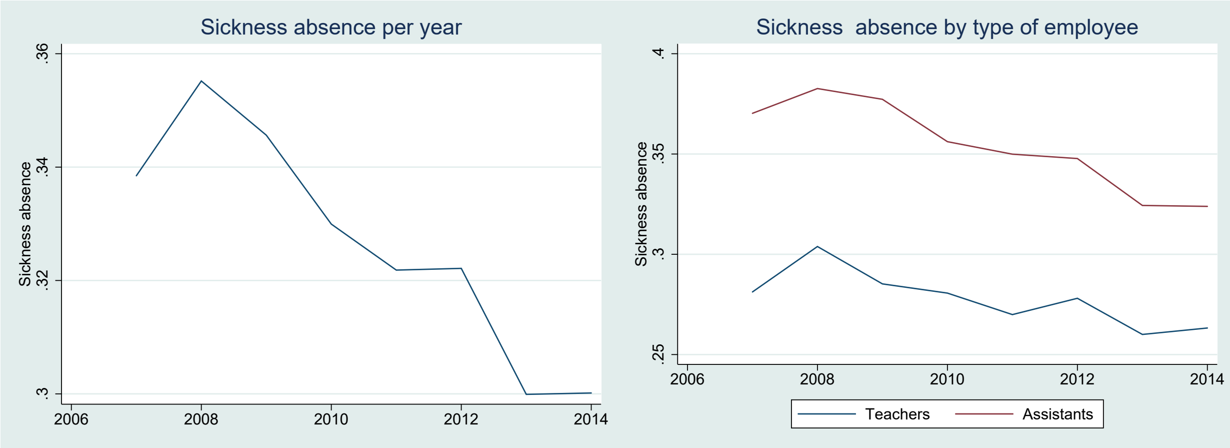
Descriptive findings

We start by looking at how sickness absence in child care centers has developed over time, and how it varies between teachers and assistants. Figure 1 shows the share of employees in child care centers with sickness absence during the years 2007-2014. We note that there is a clear downward trend over the period. There is a reduction of about 4 percentage points in the share of employees in a child care center with sickness absence in a calendar year from 2007 to 2014, from a level of around 34 percent to a level of around 30 percent. This

[6] This is about three times larger than the long-term sickness rate reported by Gørtz and Andersson (2014) (their Figure 3) for employees in child care centers in Denmark. However, their long-term measure captures only spells of more than two weeks, while we capture all spells certified by a medical doctor. Such certification is required for spells exceeding 3 days, sometimes 7 days, but is also used for shorter spells, especially among employees with high sickness absence. From Table I in Gørtz and Andersson (2014) it is evident that short-term sickness by far exceeds long-term in Denmark, and the underlying sickness absence may thus not be very different in Denmark and Norway. Denmark and Norway have generous welfare systems compared to other OECD countries. They are especially generous for those with low income (assistants). Therefore, it is not clear that the results from such a context will be transferable to other countries.

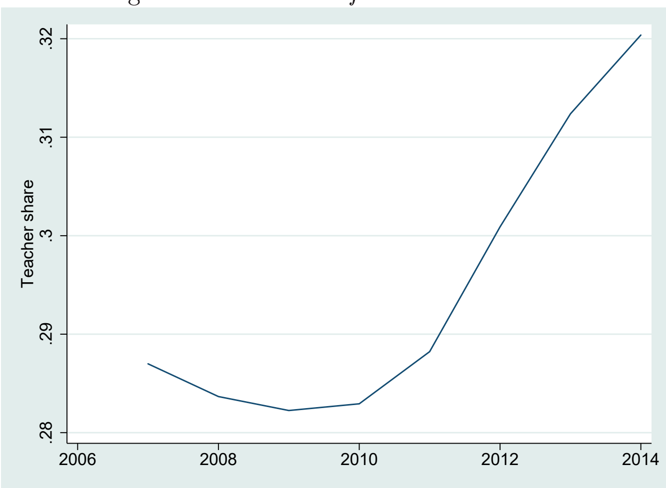
negative trend applies similarly to both teachers and teacher assistants, but we note that the sickness absence is substantially lower for teachers than for assistants.

Figure 1: *Sickness absence (in %) during a year for all employees in child care centers and by type of employees*



This suggests that the composition of teachers over assistants is likely to explain differences in sickness absence across centers. Though there is considerable variation in staff composition across centers,[7] Figure 2 shows that there has been an increase in the share of teachers among the staff in child care centers during the period. This is in line with the goal of most Norwegian political parties over the last years, particularly articulated by the non-right wing.

Figure 2: *The share of teacher over time*



The increasing share of teachers with low sickness absence over assistants with high sickness absence

[7]Figure A.1 in the Appendix shows the distribution of the share of teachers among the staff across child care centers.

contributes partly to explain the overall fall in absence in Figure 1. In fact, if the share of teachers had been constant over the period, the overall fall in sickness absence would have been 9 percent instead of the actual fall of 12 percent. This illustrates how changes in the composition of employees with different educational levels and sickness absence can significantly affect the change over time in aggregates of sickness absence, even in the possible event of no causal effects of workload.

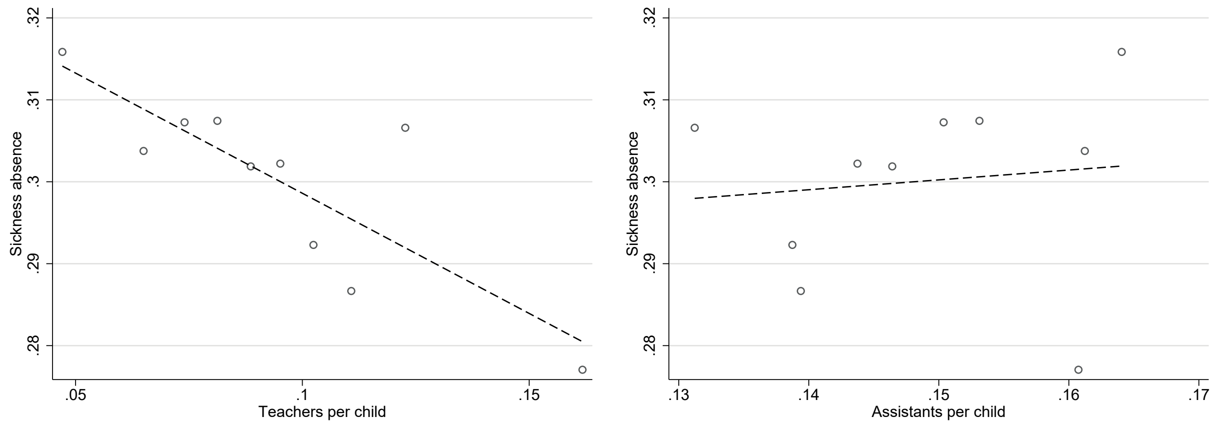
The importance of compositional effects can also be illustrated by looking at the relationship between sickness rates of centers by the centers' share of teachers and assistants per child. Figure 3 shows the relationship between sickness absence and the two ratios separately for the year 2014. Based on centiles, we see that centers with many teachers per child have lower sickness absence than centers with few teachers per child. However, for assistants it is the opposite: Centers with many assistants have higher sickness absence than centers with few assistants per child.

There are two points from these figures that we explore further below. First, the level of sickness absence and the association between workload and sickness absence differ substantially between the college-educated teachers and the assistants with no or limited higher education. Looking at aggregates on sickness absence over these two groups can yield very confusing results. Second, drawing causal inference from these observational data is not straightforward. In particular, it seems difficult to come up with convincing theoretical arguments that can explain how reduced workload in the form of more assistants, could result in an individual assistant becoming more sick (i.e. the positive correlation in Figure 3).[8] However, it is not that hard to come up with sensible explanations for sickness absence to increase based on compositional changes in terms of a higher share of assistants at the center level, selection or reversed causality. When using data aggregated to the municipal or center level, it is thus crucial to control for the composition of groups with differing latent sickness absence. This can be done using observational data on e.g. education, but such latent differences may also be unobservable, and thus hard to adequately control for. Similarly, employees with low latent sickness absence may self-select to well-staffed centers with low sickness absence, again resulting in correlations between adults per child and sickness absence that are not related to causal effects of workload on individuals' sickness

[8]Though not convincing, it is possible to come up with arguments to explain how randomly assigning more adults (e.g. assistants) per child can raise sickness absence. If the staff increases, the increase in workload on my colleagues from me being sick absent may decline. The social disapproval facing absent workers may then decline, and thus in theory sickness absence could increase. Also, in the empirically irrelevant case of over-crowding of employees in the centers, one could imagine that workload could decline if excessive employees were sick absent.

absence. Biases can also evolve from reverse causality, e.g. if the center hires more assistants because sickness absence is expected to be high in the future. This could happen if demanding children are expected to enter the center, or if the center is unable to recruit teachers. These issues represent threats to estimating reliable causal effects of workload on sickness absence using observational data. In the following, we will try to address them.

Figure 3: *Fitted values of sickness absence and the two ratios for the year 2014*



Regression results

We start by showing results from naive regressions illustrated in Figure 3. In all regressions we use the natural log of the number of employees per child, meaning that we estimate how a one percent change in the number of employees per child is associated with the percentage point change in sickness absence. From Table 2 we see that sickness absence in a child care center is 7.2 percentage points higher when the number of adults per child is one percent higher. When we add controls we see that the estimate decreases somewhat (to 6.1 percentage points), in line with what we would expect if observable characteristics correct for some of the likely selection. As we have discussed above and saw in Figure 3, the positive association stems from opposite correlations for teachers and assistants: A higher share of assistants is associated with a higher probability of sickness absence among the staff, whereas a higher share of teachers is associated with a lower probability of sickness absence among the staff.

Table 2: Associations between the three different ratios and sickness absence, OLS

	No controls		With controls	
	Coef.	Std. err.	Coef.	Std. err.
Log adults per child	0.072	0.009***	0.061	0.008***
R-squared	0.001		0.014	
Log teachers per child	-0.029	0.010***	-0.023	0.011**
R-squared	0.001		0.017	
Log assistants per child	0.080	0.009***	0.064	0.009***
R-squared	0.003		0.015	

Note: Control variables are gender, age, experience, experience squared, the share of children under 3 years old, and year dummies. Standard errors are clustered on municipality level.**/*** denotes statistically significant at the 5/1 percent level. Number of observations = 304 470.

Choices and characteristics of the municipality may be important determinants of the workplace of child care staff, and in Table 3 we report estimates that account for time-invariant (observable and non-observable) municipality characteristics. The association between adults per child and sickness absence remains positive, but - again as expected - declines somewhat compared with the model with only observable control variables in Table 2. The same holds for assistants per child. For the teachers per child, the estimate declines somewhat (in absolute value), but it remains negative and statistically significant.

Turning to model 2 of Table 3, we consider estimates from a model that accounts for time-invariant (observable and non-observable) individual characteristics. We see from the table that results on adults and assistants per child remain similar to results from the model with municipality fixed effects, though again associations drop somewhat. More teachers per child, however, is no longer statistically significantly associated with lower sickness absence. This may be taken to suggest that the negative estimates above are biased by omitted individual characteristics, like time-invariant selection by health or education. If the fixed effects model adequately accounts for such selection, the results suggest that reduced workload, in the form of more teachers per child, do not reduce sickness absence.

As noted above, however, it is hard to see how more assistants *per se* could causally increase sickness absence, and we may thus take this to suggest that more assistants are associated with some contemporaneous events that are detrimental to sickness absence. Such events could be more demanding children, not being fully compensated for by the additional assistants, or foreseeing higher sickness absence of the staff leading to more assistants being hired, or that assistants are hired to replace sick teachers (i.e. reverse causality).

Table 3: Sickness absence, fixed effect models

	Municipality fixed-effects		Individual fixed-effects	
	Coef.	Std. err.	Coef.	Std. err.
Log adults per child	0.057	0.008***	0.038	0.006***
R-squared	0.012		0.001	
Log teachers per child	-0.014	0.005***	0.004	0.003
R-squared	0.006		0.001	
Log assistants per child	0.058	0.006***	0.029	(0.004)***
R-squared	0.013		0.001	

Note: Time dummies are included in all regressions, so are controls for gender, age, experience, experience squared, and the share of teachers under the age of three. Standard errors are clustered on municipality level in model 1, and on individual level in model 2. Running a model with center fixed effects gives the same results as the individual fixed effect model. *** denotes statistically significant at the 1 percent level. Number of observations = 304 470.

Similar issues could plague the results for the teachers.

Seen together, our results indicate that workforce composition and not workload is very important in understanding the observed relationship between the number of adults and sickness absence in child care centers. Selection or reverse causality is likely to fundamentally influence the interpretation of the results from our models.[9]

RDD and IV results

While the results from the individual fixed effects models suggest no or a negative effect of teachers per child on sickness absence, we need plausibly exogenous variation in the number of teachers per child to be able to give the results a credible causal interpretation. In an attempt to do so, we follow Fiva et al. (2016) and exploit variation in which political block got into power in municipal councils in Norway.[10] We first focus on the sample of municipalities where the non-right block, which argues more strongly for child care funding and more college-educated teachers in child care centers, obtained from 45 to 55 percent of the votes. This means that our data set is now a subset of the data set used in the previous section (we keep 1/3 of the observations).

[9] We also run sub-sample analyses based on the municipality fixed effects specification based on only teachers and assistants respectively. We find no significant association between the number of teachers per child and teachers' sickness absence. However, more assistants are associated with higher sickness absence among the assistants. These results echo the individual fixed effect results. Based on these sub-samples, we also look at spillover effects. We find that more assistants are associated with higher sickness absence among the teachers, whereas there is no significant association between teachers per child and assistants' sickness absence.

[10] There are in total 424 municipal councils in Norway in the period 2007-2014 and they are elected in September every fourth year. Our sample covers two election periods: 2007-2010 and 2011-2014. We group all the political parties into two blocks according to their inclination to prioritize funding of child care: a non-right block (high priority) and a right block (lower priority). The right block consists of the conservative party (H) and the progress party (FRP). The non-right block consists of the remaining ones. The additional data used are from Fiva et al. (2016); see http://www.jon.fiva.no/data.htm.

Figure 4 shows fitted values of a regression model with the number of teachers per child on the RHS and the cut-off dummy as the explanatory variable. The figure indicates that there are more teachers per child in municipalities with a non-right local government, in line with the non-right parties' rhetoric and stated political priorities (see also findings in Fiva et al. 2016).

Figure 4: *Teachers per child in municipalities where the non-right block holds/is close to holding the majority*

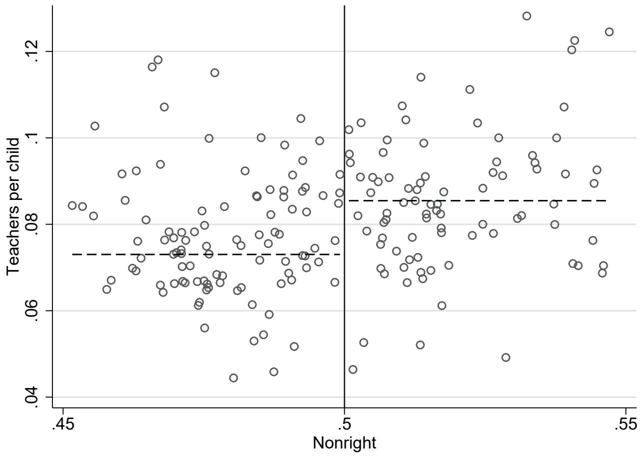


Table 4 shows the results from regressions on Eqs. (2) and (3), as well as reduced form estimates. In line with Figure 4, the first stage estimate suggests that if the non-right block gets just above 50 percent of the votes, the number of teachers per child increases discontinuously by about 18 percent.[11]

Table 4: Results from the RDD and IV

		Without controls		With controls	
Dependent variable	Explanatory variable	Coef.	Std. err.	Coef.	Std. err.
First stage:					
Log teachers per child	Above 50 % non-right	0.19	0.057***	0.18	0.057***
F-statistics		10.62		10.17	
Reduced form:					
Sickness absence	Above 50 % non-right	-0.03	0.014**	-0.03	0.014**
Second stage:					
Sickness absence	Log teachers per child	-0.15	0.046***	-0.16	0.052***

Note: Bandwidth is 0.45-0.55. Control variables include gender, age, experience, experience squared and the share of children under three years of age. Standard errors are clustered on municipality level. **/*** denotes statistically significant at the 5/1 percent level. Number of observations = 99 209.

[11]In line with the rhetoric of the parties, we find no similarly clear difference in the number of adults or assistants per child around the discontinuity, which disables us from applying the instrument for those ratios.

Table 4 also shows the reduced form estimate, which captures the direct effect of having a non-right local government on sickness absence in the centers. The point estimate suggests that the sickness absence is lowered by 3 percentage points if the non-right wing obtains the majority. Given previous findings that the non-right block attributes significantly more resources to education and child care, this finding may be taken to indicate that more resources to the centers can lower sickness absence among teachers and assistants.

As noted above, to attribute this reduced form estimate solely to changes in the number of teachers per child requires strong additional assumptions (i.e. the exclusion condition). But if we are willing to assume that the non-right majority affects sickness absence solely through changes in the number of teachers per child, the second stage estimate implies that a one percent increase in teachers per child reduces sickness absence in child care centers by about 15 percentage points, from a baseline of around 34 percent. Running the regressions with or without covariates do not change these results.[12] Table A.1 in the Appendix provides indications of robustness of these results to variation in bandwidth, exclusion of observations very close to the discontinuity (donuts) and local linear regression.

6 Conclusion

Given the substantial cost of sickness absence on society, implementing measures to reduce it is important. Workplace conditions have been shown to be central risk factors for sickness absence (Labriola et al., 2006; Eriksen et al., 2016), but little is known about possible empirical effects of various indicators of workload (Bratberg et al., 2017; Gørtz and Andersson, 2014; Conen et al., 2012; Defebvre, 2018). We use the number of adults per child in Norwegian child care centers as a proxy for workload to explore if it influences sickness absence. Extending a former study looking at employees in child care centers in Denmark (Gørtz and Andersson, 2014), we distinguish between college-educated teachers and assistants with no or limited higher education and estimate associations separately for these groups. This distinction allows us to pay particular attention to methodological challenges related to changes in the composition of employees with inherently high and low sickness absence.

[12]We estimate the local average treatment effect (LATE), which is the average effect of increasing the number of teachers per child on sickness absence for those whose treatment status has been changed by the instrument. Hence, municipalities are treated if the instrument is switched on ($T_{kt} = 1$) and untreated if the instrument is switched off ($T_{kt} = 0$).

In line with the findings of Gørtz and Andersson (2014), our results (based on OLS) show that more adults per child are *not* associated with lower sickness absence. However, decomposing the number of adults into teachers and assistants reveals that more teachers per child are associated with lower sickness absence while more assistants per child are not. When accounting for observable and unobservable time-invariant municipality fixed effects, the associations decline. Moreover, when we similarly account for individual fixed effects, where no variation in e.g. time-invariant health status or education remain, the estimate on teachers per child becomes insignificant. However, the estimate for assistants per child remains positive and statistically significant, suggesting that even the individual fixed effects model may suffer from omitted variable bias or reverse causality.

Trying to address possible model deficiencies, we use results from municipal elections where the non-right parties obtained just about 50 percent of the votes (Fiva et al., 2016). Based on this regression discontinuity design, we find that the number of teachers per child increases discontinuously by about 18 percent at the discontinuity, with an associated reduced form effect of a drop in sickness absence of 3 percentage points (about 10 percent). If we attribute this reduced form effect solely to increases in the number of teachers per child, the local average treatment effect (LATE) estimate suggests that a one percent increase in the number of teachers per child reduces sickness absence by about 15 percentage points from a baseline of around 34 percent. This estimate is likely to be upward biased, as the exclusion restriction is unlikely to hold, since the non-right parties may prioritize the children and employees in other ways than solely through more teachers (Fiva et al., 2016). The findings from the individual fixed effects models and the reduced form model suggest that there may be none or just a weak beneficial effect on sickness absence. The lack of similar findings for the assistants, casts doubt, however, on a general hypothesis that workload affects sickness absence in Norwegian child care institutions.

Our analysis underlines that evaluating the effects of workload on sickness absence is difficult. Policy makers may want to improve work conditions or the quality of the produced good (in our study, the development of the children) by measures meant to increase the number of employees. Such measures will typically be very costly, but costs calculated by mechanically looking at the increase in salaries may not be accurate. Substituting workers with high levels of sickness absence, often low-educated, with workers with low levels of sickness absence, often high-educated, may not increase costs to the same extent as the higher salaries of the low-sickness workers, because the sickness absence of these workers is also lower. Our analysis suggests that such compositional effects may be more important than causal effects of workload on sickness absence in Norwegian child care centers.

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Appendix

Figure A.1: Staff composition

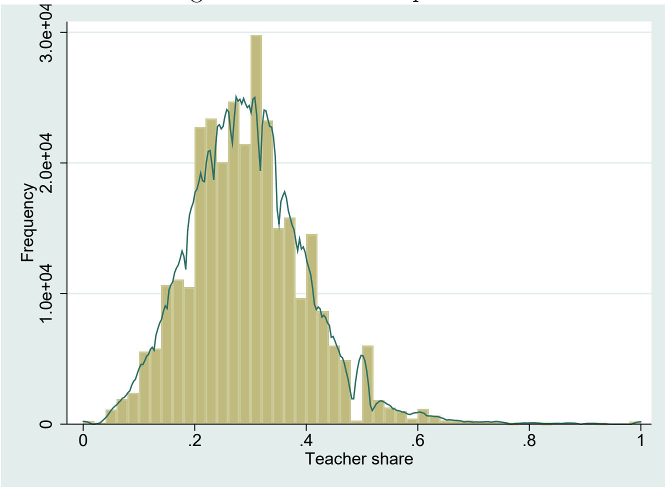

Table A.1: IV-results - robustness over the choice of bandwidth, donut and local linear regression

		Ref. model	Varying bandwidth				Donut		Non-parametric	
	Bandwidth	0.45-0.55	0.44-0.56	0.425-0.575	0.46-0.54	0.475-0.525	0.46-0.54	0.475-0.525	0.45-0.55	0.425-0.575
Dependent variable	Explanatory variable									
First stage:										
Log teacher per child	Above 50% non-right	0.18	0.18	0.15	0.15	0.14	0.23	0.27	0.069	0.063
		(0.057)	(0.057)	(0.042)	(0.034)	(0.033)	(0.048)	(0.058)	(0.00085)	(0.00086)
F-statistics		10.17	9.8	12.4	18.8	18.9	22.7	21.4		
Reduced form:										
Sickness absence	Above 50% non-right	-0.03	-0.018	-0.016	-0.023	-0.017	-0.043	-0.052	-0.008	-0.008
		(0.014)	(0.008)	(0.009)	(0.008)	(0.009)	(0.012)	(0.018)	(0.00086)	(0.00087)
Second stage:										
Sickness absence	Log teacher per child	-0.16	-0.10	-0.13	-0.15	-0.12	-0.19	-0.19	-0.12	-0.13
		(0.052)	(0.051)	(0.062)	(0.039)	(0.055)	(0.036)	(0.055)	(0.001)	(0.001)
N		99 209	109 280	126 473	86 093	51 044	69 908	34 859	99 209	126 473

Note: No control variables are included. Running the regressions with covariates do not change the results. In the “donut" RDD, we exclude a small range of the sample very close to the cut-off (i.e. 0.49-0.51). Standard errors (in parentheses) are clustered on municipality level, except in the non-parametric model where we use a bootstrap method. For the non-parametric model, note that our explanatory variable (above 50% non-right) is a dummy variable. We therefore run a local constant regression and our kernel is liracine.

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