Model

- in general I want to estimate something like

$$\Delta C_{it} = \theta(X_{it})R_{it} + g(X_{it}, W_{it}) + \epsilon_{it}$$
$$R_{it} = h(X_{it}, W_{it}) + u_{it}$$

- individual level fixed effect is NOT necessary because looking at first difference of C_{it}
- what about seasonality?

Seasonality

- in linear model use dummies or demean by period averages
- demeaning approach not valid in semi-parametric approach because this

$$\Delta C_{it} - \frac{1}{N}\sum_{i=1}^{N}\Delta C_{it} = \theta(X_{it})R_{it} - \frac{1}{N}\sum_{i=1}^{N}\theta(X_{it})R_{it}$$
$$+ g(X_{it}, W_{it}) - \frac{1}{N}\sum_{i=1}^{N}g(X_{it}, W_{it})$$
$$\tag{1}$$
$$+ \epsilon_{it}$$

Panel DML approach

Seasonality

- is not feasible: unnecessarily hard to interpret and estimate - inference results no longer valid because I would have to adjust the whole estimator (and thus covariance matrix)

- however, just demeaning data results in

$$\Delta \hat{C}_{it} = \theta(\hat{X}_{it})\hat{R}_{it} + g(\hat{X}_{it}, \hat{W}_{it}) + \epsilon_{it}$$
$$\hat{R}_{it} = h(\hat{X}_{it}, \hat{W}_{it}) + u_{it}$$

- where $\hat{X} = X_{it} - \frac{1}{N}\sum_{t=1}^{N} X_{it}$

- which is only equal to (1) if $g(\cdot, \cdot)$ and $h(\cdot, \cdot)$ are linear and θ doesn't depend on X_{it}

Panel DML approach

Seasonality

- for individual level fixed effects econML docs suggest to simply throw the OneHotEconded dummies into the estimator

- is this a feasible option for the monthly dummies, too? After all, why shouldn't it be?

- when throwing them in actually also able to catch interactions between month and observables - maybe having children plays a larger role in winter etc...