MLaE: Whether WFH affect well-being

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2023-05-29

Research Motivation

- During the COVID-19 pandemic, there are a lot of workers were asked to work form home because of lock-down.
- The question we want to examine is:
  During the pandemic, is the **well-being index** of home workers lower?
- Our hypothesis is that working from home has negative impact on workers' well-being, since they might feel socially isolated.

Literature

- Marco Bertoni,Danilo Cavapozzi et al.*(2022), "Remote Working and Mental Health During the First Wave of the COVID-19 Pandemic"

Data Source

IPUMS Time Use 2021, which is cross-sectional individual-level survey data.

- We dropped all the observations do not answer whether they are working from home or not, as well as excluded those observations with no job and no income.
- Y_i represents an outcome of interest:
  - `Well-being index`: 0~10, 0 for the worst life, 10 for the best life
- D_i represents a binary treatment of interest:
  - `Distance working or not` : 1 for distance worker, 0 for commuter
- X_i represents the a set of control variables:
  - `Occupation`, `marrital status`,`age`, `race`, `sex`, `have child or not`, `full-time or part-time`, `earning per week`, `State`
- # of observations: 3,281, # of variables: 94

Assumptions

- We assume that unconfoundedness is satisfied, which is:

$$(Y_{i(0)}, Y_{i(1)}) \perp D_i | X_i$$

- The sparsity assumption holds

Model

Model

Poisson regression

Because our Y is a count data, we use poisson regression with double machine learning to specify our treatment effect.

Recall: Poisson

- poisson pdf:
  - If $Y \sim poisson(\lambda)$, then $f(y) = \frac{\lambda^y e^{-\lambda}}{y!}$
- poisson regression: let $\lambda_i = E(y_i|X_i) = exp(X_i'\beta)$,
  - The conditional pdf is $f(y_i|X_i) = \frac{exp(X_i'\beta)^{y_i} e^{-exp(X_i'\beta)}}{y_i!}$
  - The log-likelihood is $\ell(\beta|y_i, X_i) = y_i(X_i'\beta) - exp(-X'\beta) - ln(y_i!)$
  - The poisson regression LASSO criterion is

$$min_{\beta,\gamma} Q(\beta, \gamma|X, Y) = -n^{-1} \sum_{i=1}^{n} \ell(\beta|y_i, X_i) + \gamma \sum_{j=1}^{p} |\beta_j|$$

XPOPOSSION

Cross-fit partialing-out lasso Poisson regression, the model is:

$$E(y_i|D, X) = exp(D_i\alpha + X_i'\beta)$$

where

- y_i is the dep. variable.
- D_i is treatment, which is a scalar.
- X_i is the control variable vector, which is a $p \times 1$ vector.
- β is a $p \times 1$ vector.

XPOLPR algorithm

Step 1

Randomly Partition the sample to K folds.

Step 2

Define two sets:

- I_k: the obs. in fold k
- IC_k: the obs. not in fold k

XPOLPR algorithm

Step 3

Run Double Selection poisson lasso For $k = 1, ..., K$

1. Using all $i \in IC_k$, run poisson lasso for the following model

$$y_i = exp(D_i \alpha_k + X_i' \beta_k)$$

   and we get the non-zero covariates, denoted by $\tilde{X}_{k,y}$.

2. Using all $i \in IC_k$, run poisson regression for the following model

$$y_i = exp(D_i \alpha_k + \tilde{X}_{k,y,i}' \beta_k)$$

   and we get the estimated coefficients $\tilde{\alpha}_k$ and $\tilde{\delta}_k$.

XPOLPR algorithm

3. For the obs. $i \in I_k$, fill in the prediction for the high-dimensional component using the out-of-sample estimate $\tilde{\delta}_k$.

$$\tilde{s}_i = \tilde{X}'_{k,y,i}\tilde{\delta}_k$$

4. Using the observations $i \in IC_k$, perform a linear lasso of D on X using observation-level weights, w_i.

$$w_i = exp'(D_i\tilde{\alpha}_k + \tilde{s}_i)$$

Denote the selected controls by $\tilde{X}_k$.

XPOLPR algorithm

5. Using the observations $i \in IC_k$, fit a linear regression of D on $\tilde{X}_k$, and denote the coefficient estimates by $\hat{\gamma}_k$.
6. For each observation $i \in I_k$, fill in the instrument

$$z_i = D_i - \tilde{X}_{k,i}\hat{\gamma}_k'$$

XPOLPR algorithm

Step 4

Compute the point estimates $\hat{\alpha}$ by solving the following sample-moment equations.

$$\frac{1}{n}\sum_{i=1}^{n}\{y_i - exp(D_i\alpha' + \tilde{s}_i)\}z_i = 0$$

XPOLPR algorithm

Step 5

Variance estimation is estimated by

$$\hat{Var}(\hat{\alpha}) = n^{-1}\hat{J}_0^{-1}\hat{\Psi}(\hat{J}_0^{-1})'$$

where

$$\hat{\Psi} = K^{-1}\sum_{k=1}^{K}\hat{\Psi}_k$$

$$\hat{\Psi}_k = n_k^{-1}\sum_{i\in I_k}\hat{\psi}_i\hat{\psi}_i'$$

$$\hat{\psi}_i = \{y_i - exp(d\hat{\alpha} + \hat{s}_i)\}z_i$$

$$\hat{J}_0 = K^{-1}\sum_{k=1}^{K}(n_k^{-1}\sum_{i\in I_k}\hat{\psi}_i^{\alpha})$$

$$\hat{\psi}_i^{\alpha} = \frac{\partial\hat{\psi}_i}{\partial\hat{\alpha}}$$

analysis

Descriptive Statistics

	mean	standard deviation
well being	7.286	1.780
WFH	0.253	0.435
age	44.265	13.552
female	0.486	0.500
have child	0.437	0.496
married	0.527	0.499
earnings per week	1277.225	793.090
fulltime job	1.134	0.341
observations	3281	

Main Result

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
Estimating lasso for distance_work using plugin

Cross-fit partialing-out             Number of obs             =      3,281
Poisson model                        Number of controls        =         94
                                     Number of selected controls =       20
                                     Number of folds in cross-fit =      10
                                     Number of resamples       =          1
                                     Wald chi2(1)              =       3.80
                                     Prob > chi2               =     0.0513
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9794901	.0104156	-1.95	0.051	.9592871	1.000119

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: gender

male:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: female dropped because it is constant
Estimating lasso for distance_work using plugin
note: female dropped because it is constant

Cross-fit partialing-out             Number of obs                =      1,686
Poisson model                        Number of controls           =         94
                                     Number of selected controls  =         21
                                     Number of folds in cross-fit =         10
                                     Number of resamples          =          1
                                     Wald chi2(1)                 =       4.33
                                     Prob > chi2                  =     0.0375
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9677906	.0152292	-2.08	0.037	.9383974	.9981044

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: gender

female:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: female dropped because it is constant
Estimating lasso for distance_work using plugin
note: female dropped because it is constant

Cross-fit partialing-out            Number of obs               =      1,595
Poisson model                       Number of controls          =         94
                                    Number of selected controls =         17
                                    Number of folds in cross-fit =        10
                                    Number of resamples         =          1
                                    Wald chi2(1)                =       0.35
                                    Prob > chi2                 =     0.5548
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9914048	.0144921	-0.59	0.555	.9634039	1.02022

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: have children or not

have children:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: hh_child dropped because it is constant
Estimating lasso for distance_work using plugin
note: hh_child dropped because it is constant

Cross-fit partialing-out              Number of obs               =      1,433
Poisson model                         Number of controls          =         94
                                      Number of selected controls =         13
                                      Number of folds in cross-fit =        10
                                      Number of resamples         =          1
                                      Wald chi2(1)                =       0.33
                                      Prob > chi2                 =     0.5628
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9914021	.0147933	-0.58	0.563	.9628277	1.020825

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: have children or not

do not have any child:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: hh_child dropped because it is constant
Estimating lasso for distance_work using plugin
note: hh_child dropped because it is constant

Cross-fit partialing-out            Number of obs                =      1,848
Poisson model                       Number of controls           =         94
                                    Number of selected controls  =         18
                                    Number of folds in cross-fit =         10
                                    Number of resamples          =          1
                                    Wald chi2(1)                 =       4.24
                                    Prob > chi2                  =     0.0396
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9700444	.0143347	-2.06	0.040	.9423518	.9985507

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: marital status

married:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
Estimating lasso for distance_work using plugin

Cross-fit partialing-out            Number of obs               =      1,728
Poisson model                       Number of controls          =         94
                                    Number of selected controls =         18
                                    Number of folds in cross-fit =        10
                                    Number of resamples         =          1
                                    Wald chi2(1)                =       1.01
                                    Prob > chi2                 =     0.3161
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9880929	.0118057	-1.00	0.316	.9652229	1.011505

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Subgroup: marital status

not married:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
Estimating lasso for distance_work using plugin

Cross-fit partialing-out            Number of obs              =      1,553
Poisson model                       Number of controls         =         94
                                    Number of selected controls =        17
                                    Number of folds in cross-fit =       10
                                    Number of resamples        =          1
                                    Wald chi2(1)               =       4.03
                                    Prob > chi2                =     0.0447

------------------------------------------------------------------------------
             |               Robust
    wbladder |        IRR   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
distance_work |   .9644475   .0173882   -2.01   0.045     .9309622    .9991371
------------------------------------------------------------------------------
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.

.
```

Subgroup: single and married men

single men:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: female dropped because it is constant
Estimating lasso for distance_work using plugin
note: female dropped because it is constant

Cross-fit partialing-out            Number of obs               =        735
Poisson model                       Number of controls          =         94
                                    Number of selected controls =         18
                                    Number of folds in cross-fit =        10
                                    Number of resamples         =          1
                                    Wald chi2(1)                =       8.06
                                    Prob > chi2                 =     0.0045
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9219021	.0264072	-2.84	0.005	.8715709	.9751398

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.

.
```

Subgroup: single and married men

married men:

```
Cross-fit fold 10 of 10 ...
Estimating lasso for wbladder using plugin
note: female dropped because it is constant
Estimating lasso for distance_work using plugin
note: female dropped because it is constant

Cross-fit partialing-out             Number of obs                =        951
Poisson model                        Number of controls           =         94
                                     Number of selected controls  =         19
                                     Number of folds in cross-fit =         10
                                     Number of resamples          =          1
                                     Wald chi2(1)                 =       0.61
                                     Prob > chi2                  =     0.4349
```

wbladder	IRR	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	.9877181	.0156312	-0.78	0.435	.9575519	1.018835

```
Note: Chi-squared test is a Wald test of the coefficients of the variables
      of interest jointly equal to zero. Lassos select controls for model
      estimation. Type lassoinfo to see number of selected variables in each
      lasso.
```

Robustness Check: PSM

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
wbladder	Unmatched	**7.21980676**	**7.31010309**	**-.090296329**	**.071507743**	**-1.26**
	ATT	**7.21980676**	**7.40398551**	**-.184178744**	**.103629524**	**-1.78**

Note: S.E. does not take into account that the propensity score is estimated.

psmatch2: Treatment assignment	psmatch2: Common support On suppor	Total
Untreated	**2,425**	**2,425**
Treated	**828**	**828**
Total	**3,253**	**3,253**

Robustness Check: DML

```
. qddml wbladder $D ($X), kfolds(2) model(partial) cmd(rlasso) reps(5)
minimum Python version required is 2.7

DDML estimation results:
spec  r     Y learner     D learner         b        SE
 opt  1     Y2_rlasso        D1_reg    -0.115  ( 0.081)
 opt  2     Y2_rlasso        D1_reg    -0.135  ( 0.081)
 opt  3     Y2_rlasso        D1_reg    -0.127  ( 0.081)
 opt  4     Y2_rlasso        D1_reg    -0.095  ( 0.081)
 opt  5     Y2_rlasso        D1_reg    -0.110  ( 0.081)
opt = minimum MSE specification for that resample.

Mean/med.   Y learner     D learner         b        SE
 mse mn     [min-mse]         [mse]    -0.117  ( 0.082)
 mse md     [min-mse]         [mse]    -0.115  ( 0.082)

Median over min-mse specifications
y-E[y|X]  = Y2_rlasso                          Number of obs   =      3281
D-E[D|X,Z]= D1_reg
```

wbladder	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
distance_work	-.1151211	.0822525	-1.40	0.162	-.2763332	.0460909

```
Summary over 5 resamples:
       D eqn      mean       min       p25       p50       p75       max
distance_work   -0.1166   -0.1352   -0.1274   -0.1151   -0.1098   -0.0953
```

Conclusion

- Our main finding indicates that working from home slightly decreases workers' well-being by 2.05%, but this decrease is not statistically significant at a 5% significance level. However, it is approaching statistical significance.
- Working from home has a negative impact on well-being for men, but not for women.
- Additionally, married individuals reported higher levels of well-being compared to unmarried individuals.
- Specifically, working from home decreases the well-being of single men by 7.81%.

Limitation

- Using survey data may cause some problems. All the data in this study was self-reported.
- Our sample size is rather small.