Summary of Replication Efforts for Section IV.A of Chetty et al.'s "The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data"

Annais Gangolf*[1], Devansh Goyal†[1], and Samuel E. Ross‡[1]

[1]*Economics Research Club, Haverford College, Haverford, PA 19041, USA*

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1 Introduction

The Haverford Economics Research Club is a student group at Haverford College which offers students the opportunity to learn about the structure and execution of economic research. In service of this goal, we are beginning to write an extension of Section IV.A of "The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data" (Chetty et al., 2020) the extension of which concerns the effect of varied reopening strategies (i.e., multi-phase reopenings, rather than the original single-event analysis) on consumer spending, employment, and business openings. We have begun our work by attempting to replicate the paper's original findings.

*agangolf@haverford.edu
†dgoyal@haverford.edu
‡seross@haverford.edu

2 Replication

The figures listed below are our attempt to replicate Table 3 columns (1), (2), (3), (4), (5), (6), (7), (8), (9), (10) in addition to Figure 12b, Figure 12c, and Figure 12d. In each of the OLS regressions, doesOpen (or 'opener') is an indicator variable for whether the state is a treatment or control, afterEvent (or 'openTime') is an indicator variable for whether the observation is past the relevant reopening date, and isOpen (or 'reopened') is an interaction term between the preceding two variables.

2.1 Consumer Spending

Raw data obtained from the Opportunity Insights GitHub page were processed by collapsing the frequency to weekly by eliminating all non-Sunday observations. This method was used due to the raw data's format as a 7-day moving average. All other variable coding and processing was consistent with the working paper's specifications.

```
. reg spend_all doesOpen afterEvent isOpen if (timeToTreat<15 & timeToTreat>-15), cluster(statefips)

Linear regression                               Number of obs     =        200
                                                F(3, 25)          =     214.00
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2550
                                                Root MSE          =     .06063

                                  (Std. err. adjusted for 26 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
   spend_all | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |   .0303333   .0263279     1.15   0.260      -.02389    .0845567
  afterEvent |   .0657233   .0041138    15.98   0.000     .0572509    .0741958
      isOpen |   .0108167   .0060779     1.78   0.087    -.0017009    .0233343
       _cons |  -.2752333   .0108712   -25.32   0.000    -.2976229   -.2528438
------------------------------------------------------------------------------
```

Figure 1: OLS Regression performed on spend_all in doesOpen, afterEvent, and isOpen over 2-week horizon. Predicts 1.08 p.p. increase in consumer spending with reopening.

```
. reg spend_all doesOpen afterEvent isOpen if (timeToTreat<22 & timeToTreat>-22), cluster(statefips)

Linear regression                               Number of obs     =        300
                                                F(3, 25)          =     453.18
                                                Prob > F          =     0.0000
                                                R-squared         =     0.3968
                                                Root MSE          =     .05771

                                    (Std. err. adjusted for 26 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
  spend_all  | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
   doesOpen  |   .0268667   .0213269     1.26   0.219    -.0170568    .0707902
 afterEvent  |   .0906215   .0044264    20.47   0.000     .0815051    .0997379
     isOpen  |   .0059985   .0054498     1.10   0.282    -.0052256    .0172226
       _cons |  -.2855333   .0092735   -30.79   0.000    -.3046324   -.2664343
------------------------------------------------------------------------------
```

Figure 2: OLS Regression performed on spend_all in doesOpen, afterEvent, and isOpen over 3-week horizon. Predicts 0.59 p.p. increase in consumer spending with reopening.

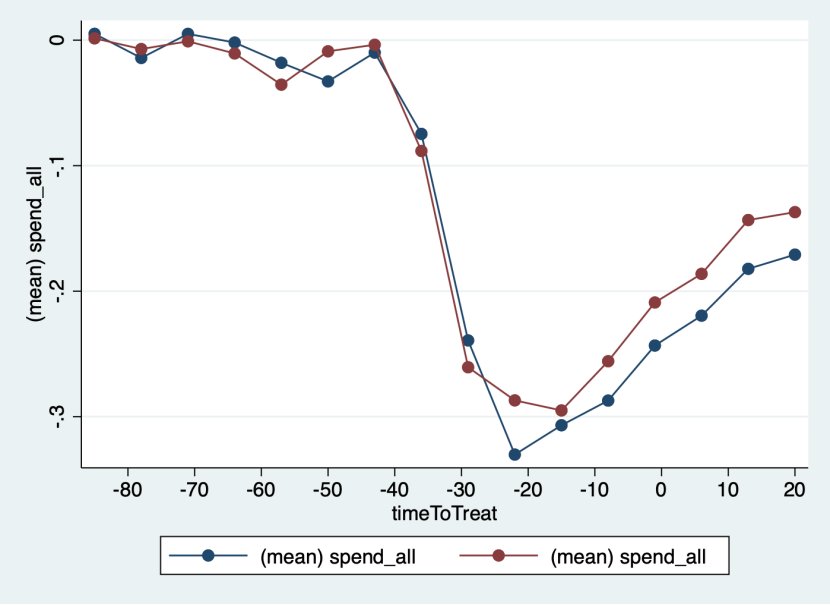

Figure 3: To create this graph, the spend_all series for the April 24th reopening date was redefined as the Thursday value, rather than the Sunday value, in order to put our event timing variable, timeToTreat, into phase across the three treatment groups. These series were then aggregated and collapsed by treatment vs. control status and time relative to treatment (timeToTreat).

2.2 Employment

Raw data obtained from the Opportunity Insights GitHub page were processed by collapsing the frequency to weekly by taking the average of each Sunday–Saturday week and attributing this mean to the Sunday's date. All other variable coding and processing was consistent with the working paper's specifications.

```
. reg emp doesOpen afterEvent isOpen if (timeToTreat<15 & timeToTreat>-15), cluster(statefips)

Linear regression                               Number of obs     =        176
                                                F(3, 18)          =       0.48
                                                Prob > F          =     0.7004
                                                R-squared         =     0.0013
                                                Root MSE          =     .04059

                                  (Std. err. adjusted for 19 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
         emp |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |  -.0057877   .0123584    -0.47   0.645    -.0317517    .0201763
  afterEvent |  -.0018899   .0020804    -0.91   0.376    -.0062606    .0024808
      isOpen |   .0027947   .0081627     0.34   0.736    -.0143546     .019944
       _cons |  -.2069028   .0106036   -19.51   0.000    -.2291802   -.1846254
------------------------------------------------------------------------------
```

Figure 4: OLS Regression performed on emp in doesOpen, afterEvent, and isOpen over 2-week horizon. Predicts 0.27 p.p. increase in employment with reopening.

```
. reg emp doesOpen afterEvent isOpen if (timeToTreat<22 & timeToTreat>-22), cluster(statefips)

Linear regression                               Number of obs     =        264
                                                F(3, 18)          =       7.55
                                                Prob > F          =     0.0018
                                                R-squared         =     0.0167
                                                Root MSE          =     .04412

                                  (Std. err. adjusted for 19 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
         emp |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |  -.0066093   .0141995    -0.47   0.647    -.0364414    .0232228
  afterEvent |  -.0116384   .0030579    -3.81   0.001    -.0180629    -.005214
      isOpen |   .0067178    .011461     0.59   0.565    -.0173608    .0307965
       _cons |  -.1897717   .0097275   -19.51   0.000    -.2102083    -.169335
------------------------------------------------------------------------------
```

Figure 5: OLS Regression performed on emp in doesOpen, afterEvent, and isOpen over 3-week horizon. Predicts 0.67 p.p. increase in employment with reopening.

```
. reg emp_incq1 doesOpen afterEvent isOpen if (timeToTreat<15 & timeToTreat>-15), cluster(statefips)

Linear regression                               Number of obs     =        180
                                                F(3, 19)          =       6.52
                                                Prob > F          =     0.0032
                                                R-squared         =     0.0389
                                                Root MSE          =     .05739

                                  (Std. err. adjusted for 20 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
   emp_incq1 | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |   .0330897   .0476901     0.69   0.496    -.0667268    .1329062
  afterEvent |  -.0116672   .0027197    -4.29   0.000    -.0173596   -.0059749
      isOpen |   .0033637   .0095059     0.35   0.727    -.0165325    .0232599
       _cons |  -.3399112   .0135545   -25.08   0.000    -.3682811   -.3115412
------------------------------------------------------------------------------
```

Figure 6: OLS Regression performed on emp_incq1 in doesOpen, afterEvent, and isOpen over 2-week horizon. Predicts 0.33 p.p. increase in first-income-quartile employment with reopening.

```
. reg emp_incq4 doesOpen afterEvent isOpen if (timeToTreat<15 & timeToTreat>-15), cluster(statefips)

Linear regression                               Number of obs     =        172
                                                F(2, 17)          =          .
                                                Prob > F          =          .
                                                R-squared         =     0.0309
                                                Root MSE          =     .04282

                                  (Std. err. adjusted for 18 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
   emp_incq4 | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |   .0119693   .0146379     0.82   0.425    -.0189139    .0428524
  afterEvent |   .0132338    .002109     6.27   0.000     .0087842    .0176833
      isOpen |   .0069305   .0069601     1.00   0.333     -.007754    .0216151
       _cons |  -.1180871   .0115562   -10.22   0.000    -.1424685   -.0937057
------------------------------------------------------------------------------
```

Figure 7: OLS Regression performed on emp_incq4 in doesOpen, afterEvent, and isOpen over 2-week horizon. Predicts 0.69 p.p. increase in fourth-income-quartile employment with reopening.

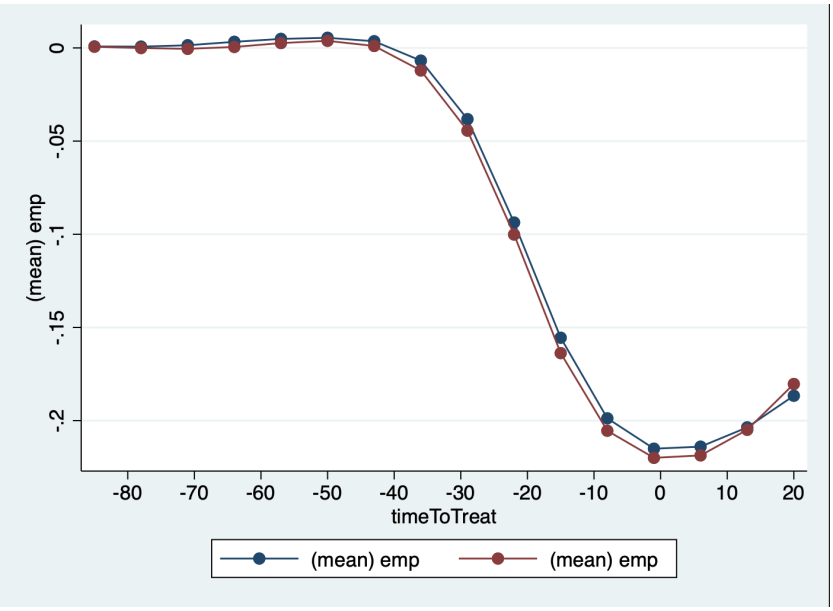

Figure 8: To create this graph, the emp series for the April 24th reopening date was redefined using a Thursday-–Wednesday week, in order to put our event timing variable, timeToTreat, into phase across the three treatment groups. These series were then aggregated and collapsed by treatment vs. control status and time relative to treatment (timeToTreat).

2.3 Small Businesses

Raw data obtained from the Opportunity Insights GitHub page were processed by collapsing the frequency to weekly by eliminating all non-Sunday observations. This method was used due to the raw data's format as a 7-day moving average. All other variable coding and processing was consistent with the working paper's specifications.

```
. reg merchants_all opener openTime reopened if (timeToTreat<14 & timeToTreat>-14), cluster(statefips)

Linear regression                               Number of obs     =        244
                                                F(3, 26)          =     208.81
                                                Prob > F          =     0.0000
                                                R-squared         =     0.1948
                                                Root MSE          =     .07533

                                  (Std. err. adjusted for 27 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
merchants_~l |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
      opener |   .0612732   .0221013     2.77   0.010     .0158434    .1067031
    openTime |   .0576696   .0025382    22.72   0.000     .0524523     .062887
    reopened |   .0291304   .0114156     2.55   0.017     .0056653    .0525954
       _cons |  -.4204732    .016315   -25.77   0.000    -.4540092   -.3869372
------------------------------------------------------------------------------
```

Figure 9: OLS Regression performed on merchants_all in opener, openTime, and reopened over 2-week horizon. Predicts 2.91 p.p. increase in open small businesses with reopening.

```
. reg merchants_all opener openTime reopened if (timeToTreat<21 & timeToTreat>-21), cluster(statefips)

Linear regression                               Number of obs     =        366
                                                F(3, 26)          =     180.66
                                                Prob > F          =     0.0000
                                                R-squared         =     0.2353
                                                Root MSE          =     .07628

                                  (Std. err. adjusted for 27 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
merchants_~l |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
      opener |   .0550571   .0203864     2.70   0.012     .0131523     .096962
    openTime |   .0695417   .0032886    21.15   0.000     .0627818    .0763016
    reopened |    .039125   .0157229     2.49   0.020     .0068061    .0714439
       _cons |  -.4225238   .0162301   -26.03   0.000    -.4558853   -.3891623
------------------------------------------------------------------------------
```

Figure 10: OLS Regression performed on merchants_all in opener, openTime, and reopened over 3-week horizon. Predicts 3.91 p.p. increase in open small businesses with reopening.

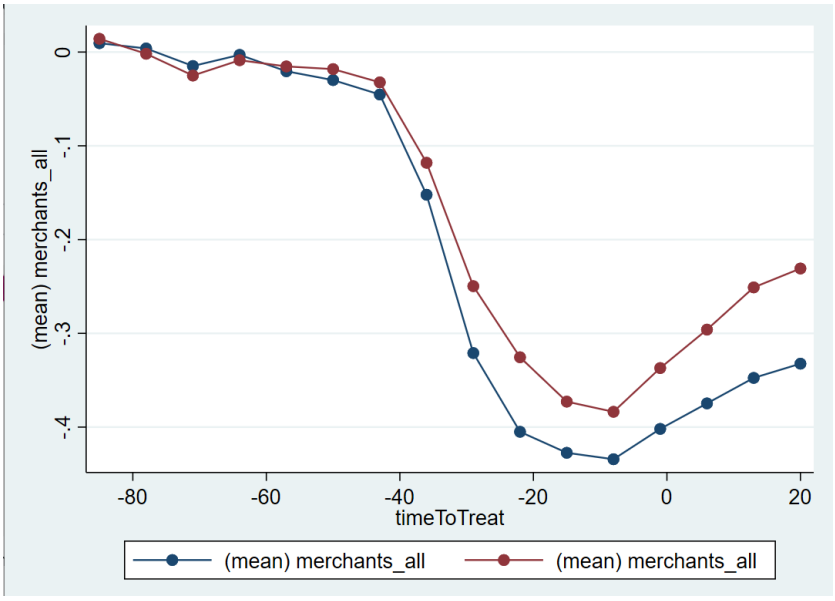

Figure 11: To create this graph, the merchants_all series for the April 24th reopening date was redefined as the Thursday value, rather than the Sunday value, in order to put our event timing variable, timeToTreat, into phase across the three treatment groups. These series were then aggregated and collapsed by treatment vs. control status and time relative to treatment (timeToTreat).

2.4 Mobility

Raw data obtained from the Opportunity Insights GitHub page were processed by collapsing the frequency to weekly by eliminating all non-Sunday observations. This method was used due to the raw data's format as a 7-day moving average. All other variable coding and processing was consistent with the working paper's specifications.

```
. reg gps_away_from_home doesOpen afterEvent isOpened if (timeToTreat<=14 & timeToTreat>=-14), cluster(statefips)

Linear regression                               Number of obs     =        112
                                                F(3, 16)          =     118.16
                                                Prob > F          =     0.0000
                                                R-squared         =     0.4536
                                                Root MSE          =     .02227

                                  (Std. err. adjusted for 17 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
gps_away_f~e |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |   .0112217   .0119448     0.94   0.361    -.0141002    .0365437
  afterEvent |   .0367609   .0026129    14.07   0.000     .0312218       .0423
    isOpened |   .0073391   .0043915     1.67   0.114    -.0019703    .0166486
       _cons |  -.2015217   .0051157   -39.39   0.000    -.2123665    -.190677
------------------------------------------------------------------------------
```

Figure 12: OLS Regression performed on gps_away_from_home in doesOpen, afterEvent, and isOpen over 2-week horizon. Predicts 0.73 p.p. increase in consumer spending with reopening.

```
. reg gps_away_from_home doesOpen afterEvent isOpened if (timeToTreat<=21 & timeToTreat>=-21), cluster(statefips)

Linear regression                               Number of obs     =        168
                                                F(3, 16)          =     130.32
                                                Prob > F          =     0.0000
                                                R-squared         =     0.5220
                                                Root MSE          =     .02253

                                  (Std. err. adjusted for 17 clusters in statefips)
------------------------------------------------------------------------------
             |               Robust
gps_away_f~e |      Coef.   Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    doesOpen |   .0073536   .0120936     0.61   0.552    -.0182837     .032991
  afterEvent |   .0426377   .0025877    16.48   0.000      .037152    .0481234
    isOpened |    .013209   .0057276     2.31   0.035      .001067    .0253509
       _cons |  -.203087    .005079   -39.99   0.000    -.213854    -.1923199
------------------------------------------------------------------------------
```

Figure 13: OLS Regression performed on gps_away_from_home in doesOpen, afterEvent, and isOpen over 3-week horizon. Predicts 1.32 p.p. increase in consumer spending with reopening.

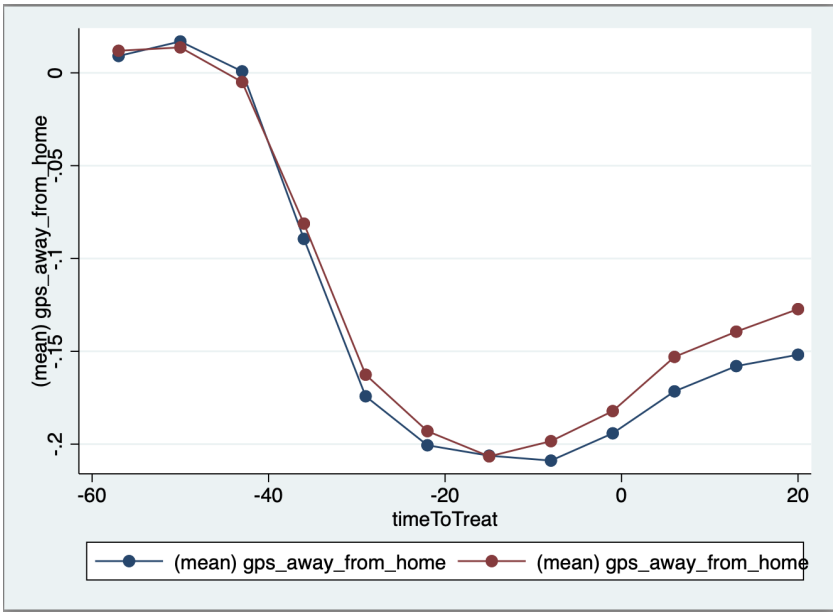

Figure 14: To create this graph, the gps_away_from_home series for the April 24th reopening date was redefined as the Thursday value, rather than the Sunday value, in order to put our event timing variable, timeToTreat, into phase across the three treatment groups. These series were then aggregated and collapsed by treatment vs. control status and time relative to treatment (timeToTreat).

3 Inconsistencies

3.1 Regression Results

None of our above regressions give results completely consistent with the working paper; for example, our regression in Figure 4 on employment with a two-week horizon gave an interaction coefficient of 0.0027 while the original paper gave 0.0065. We are not completely sure of the cause of these discrepancies, but differences in the number of observations gives a clue. In the aforementioned regression, the original paper listed 208 observations, while ours gives 176. This 32-data-point gap was traced to missing data for control states including the District of Columbia and South Dakota. Hence, we attribute most of the variability between our results and the original paper's to differences in the dataset used for each analysis rather than technical errors.

3.2 Graphs

Most of our graphs look extremely similar to those provided in the original paper, although almost all display slight discrepancies during the three or four weeks surrounding the treatment time. We attribute this variability to data set discrepancies as per the preceding discussion of missing values.

4 Stata Code

To aid in reproducibility, our STATA do-files are available on GitHub at https://github.com/AGangolf/HERC_ChettyReplication.

References

Chetty, R., Friedman, J. N., Hendren, N., Stepner, M., & Team, T. O. I. (2020). The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data. *National Bureau of Economic Research Working Paper Series*, *No. 27431*. https://doi.org/10.3386/w27431