Reply to Manovskii's Discussion on "The Limited Macroeconomic Effects of Unemployment Benefit Extensions"

Gabriel Chodorow-Reich
Harvard University and NBER

Loukas Karabarbounis
University of Minnesota and NBER

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Iourii Manovskii discussed our paper "The Limited Macroeconomic Effects of Unemployment Benefit Extensions" at the July 2016 NBER EF&G Meeting. In our webpages we have posted replies to many of Manovskii's comments that originally appeared in a comment that he coauthored on our paper (Hagedorn, Manovskii, and Mitman, 2016).

In this note we address an additional issue raised by Manovskii which was not contained in his coauthored comments. Manovskii argued that, if measurement error in unemployment is exogenous to the underlying fundamentals, then the measurement error is a valid instrument for benefit extensions in a regression of the unemployment rate on benefit extensions. Denoting by $u_{s,t}^{\text{revised}}$ the revised unemployment rate and by $T_{s,t}$ the duration of benefit extensions, he showed results from the following regression:[1]

$$u_{s,t}^{\text{revised}} = \beta T_{s,t} + \delta_s + \delta_t + e_{s,t}, \tag{1}$$

where the duration of benefit extensions $T_{s,t}$ is instrumented with the measurement error in the unemployment rate $\hat{u}_{s,t}$ and δ_s and δ_t denote state and month fixed effects. Manovskii reported a positive and statistically significant effect of benefit extensions on the unemployment rate ($\hat{\beta} > 0$), in contradiction to our main result of a statistically insignificant effect of benefit

[1] In his discussion Manovskii reported results from three specifications, each with a different endogenous variable in the right-hand side. We focus on his second specification as seemingly the most relevant to our work, but our comments apply equally well to all three.

extensions on the unemployment rate. We include as an attachment to this reply the slide from Manovskii's discussion showing this result.

We argue that Manovskii's result is misleading and incorrect for three reasons:

1. Manovskii obtained statistically significant effects only because he reported homoskedastic standard errors. He would not have found statistically significant effects had he followed the standard practice of clustering his standard errors. Clustering the standard errors produces results consistent with the main result of our paper.

2. The linear first stage of the IV regression that Manovskii performed inefficiently discards information on the exact nonlinear mapping from unemployment rate errors to UI errors. The procedure in our paper makes full use of this information to obtain much tighter estimates.

3. The IV regression that Manovskii performed obscures the issue of persistence of UI errors.

1. Manovskii used incorrect standard errors. The slide presented by Manovskii in his discussion shows a positive and statistically significant relationship between the unemployment rate and the instrumented extension of benefits. However, Manovskii inexplicably assumed a homoskedastic covariance structure of the residuals $e_{s,t}$ to reach this result. It is now well appreciated that in panel data settings such as ours, standard errors should be two-way clustered to allow for serial correlation in residuals within a state and spatial correlation in residuals within a month (Cameron and Miller, 2015). We follow this approach in our paper. Properly clustering standard errors overturns the statistical significance of the IV coefficient that Manovskii reported in his discussion.

Table 1 reports variants of the IV regression shown on the Manovskii slide.[2] In column 1 we reproduce to the third decimal place the IV regression that Manovskii ran without clustering the standard errors and which produces a positive and statistically significant effect of UI extensions

[2]Using the dataset posted on our webpages and the Stata log file attached to this reply, readers can reproduce the four regressions in Table 1 for themselves.

Table 1: Manovskii IV Regression

	Dependent variable:			
	$u_{s,t}$	$u_{s,t}$	$u_{s,t}$	$u_{s,t+1}$
	(1)	(2)	(3)	(4)
Endogenous variable:				
$T_{s,t}$	0.131^{*}	0.131	0.131	-0.054
	(0.052)	(0.196)	(0.199)	(0.215)
Instrument	$\hat{u}_{s,t}$	$\hat{u}_{s,t}$	$\hat{u}_{s,t}$	$\hat{u}_{s,t}$
State, time FE	Yes	Yes	Yes	Yes
Clustered standard errors	None	State, time	State	State, time
P-value	0.012	0.506	0.511	0.803
Observations	11,700	11,700	11,700	11,650

Notes: Column 1 reproduces exactly the regression on Manovskii's slide with homoskedastic standard errors. Column 2 clusters standard errors by state. Columns 3 and 4 two-way clusters standard errors by state and month as in CRK. $+, *, **$ denote significance at the 10, 5, and 1 percent levels, respectively.

on unemployment. In column 2, we instead two-way cluster standard errors by state and by month, consistent with the standard errors reported in our paper. Clustering raises the standard error by a factor of nearly four, such that the coefficient is not statistically significant. In column 3 we cluster standard errors only by state. While possibly Manovskii was not aware of the advent of two-way clustering, in his own work (Hagedorn, Karahan, Manovskii, and Mitman, 2015) he has acknowledged the seminal contribution of Bertrand, Duflo, and Mullainathan (2004) that argues that standard errors in a state-time panel should be at least clustered by state. Column 3 shows that clustering on just this dimension produces standard errors essentially identical to those which result from two-way clustering. Finally, to illustrate why clustered standard errors give a better guide to inference, in column 4 we repeat the IV regression but forwarding the dependent variable by one period. The estimated coefficient reverses sign, which makes little economic sense, but remains statistically insignificant when properly adjusting for the standard errors.

We are puzzled by Manovskii's choice to report homoscedastic standard errors on his slide. This choice caused him to report standard errors too small by a factor of four. Further, Manovskii did not alert the audience to his peculiar choice of standard errors and this choice is not mentioned anywhere in the slides that he posted on the NBER website.

2. IV is inefficient. The variability of the estimated coefficient and the large standard errors reflect the inefficiency of a linear IV regression when applied to a transformation that is nonlinear. Instrumenting benefit extensions $T_{s,t}$ with the measurement error $\hat{u}_{s,t}$ in a linear IV regression is extremely inefficient because it forces linearity onto a highly nonlinear relationship. As we discuss in our paper, there are many instances where substantial measurement error in the unemployment rate does not affect benefit extensions because the economy is not close to a UI trigger threshold. The linear first stage relationship imposed by IV ignores the researcher's knowledge of the exact mapping between the measurement error in the unemployment rate and benefit extensions. Our construction of the UI error $\hat{T}$ makes use of exactly this additional information, allowing us to make much tighter inference than does the linear IV regression.

3. Persistence and IV. Finally, in our paper we discuss the persistence of the unemployment rate errors and of the resulting UI errors. This persistence motivates our construction of the UI error innovation, a serially uncorrelated innovation to the UI error, as our main regressor. We then report the impulse response of the UI error to a UI error innovation. The IV regression presented by Manovskii sweeps the issue of persistence under the rug.

References

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Differences-In-Differences Estimates?," *The Quarterly Journal of Economics*, 119(1), 249–275.

Cameron, C., and D. Miller (2015): "A Practitioners Guide to Cluster-Robust Inference," *Journal of Human Resources*, 50(2), 317–372.

Hagedorn, M., F. Karahan, I. Manovskii, and K. Mitman (2015): "Unemployment Benefits and Unemployment in the Great Recession: The Role of Macro Effects," NBER Working Paper No. 19499.

Hagedorn, M., I. Manovskii, and K. Mitman (2016): "Interpreting Recent Quasi-Experimental Evidence on the Effects of Unemployment Benefit Extensions," Working Paper 22280, National Bureau of Economic Research.

Attachment 1: Slide from Manovskii discussion

Can We Overcome the Bias?

- CRK's interpretation:
  - Revised unemployment measure, $\tilde{u}_{s,t}$, is the truth,
  - Real-time measure, $u_{s,t}$, is the truth + a random error $\hat{u}_{s,t}$:

$$u_{s,t} = \tilde{u}_{s,t} + \hat{u}_{s,t}.$$

- Taking CRK's idea seriously, the exogenous measurement error, $\hat{u}_{s,t}$, is a perfect instrument: correlated with benefits and benefit errors, but independent of $\tilde{u}_{s,t}$.
- The right regression then uses $\hat{u}_{s,t}$ as an instrument:

$$\begin{aligned}
\tilde{u}_{s,t} &= \mathbf{0.208}\,(s.e.\,0.092)\,\hat{T}_{s,t} + \delta_s + \delta_t + \epsilon^{\hat{T}}_{s,t} \\
\tilde{u}_{s,t} &= \mathbf{0.131}\,(s.e.\,0.052)\,T_{s,t} + \delta_s + \delta_t + \epsilon^{T}_{s,t} \\
\tilde{u}_{s,t} &= \mathbf{0.573}\,(s.e.\,0.275)\,\nu_{s,t} + \delta_s + \delta_t + \epsilon^{\nu}_{s,t}
\end{aligned}$$

- The effects are huge, e.g. 0.573*17*18=175, or an increase in unemployment by 175 p.p. $\left(\text{coef.} * \frac{99-26}{4.3} * \frac{54\,\text{mo. ext. ben. policy in place during Gr. Ress.}}{3\,\text{mo. ext. ben. policy in place after CRK innov.}}\right)$

Attachment 2: Stata log file

```
.
. copy http://scholar.harvard.edu/files/chodorow-reich/files/crk_ui_macro_dataset.zip crk_ui_macro_dataset.zip, replace
(note: file crk_ui_macro_dataset.zip not found)

. unzipfile crk_ui_macro_dataset.zip, replace
    inflating: crk_ui_macro_dataset.dta
successfully unzipped crk_ui_macro_dataset.zip to current directory

. use crk_ui_macro_dataset, clear
(Chodorow-Reich and Karabarbounis (2016) Macro UI Data Set)

. erase crk_ui_macro_dataset.zip

.
. gen u_error = u_realtime-u_revised

. encode state, gen(state_n)

. tsset state_n monthly
       panel variable:  state_n (strongly balanced)
        time variable:  monthly, 1996m1 to 2015m9
                delta:  1 month

.
. *Manovskii regression 1, homoskedastic standard errors
. reghdfe u_revised (T_hat=u_error) if baseline, absorb(state_n monthly)
(converged in 3 iterations)

HDFE IV (2SLS) estimation
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Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only
                                                      Number of obs =    11700
                                                      F(  1, 11416) =     5.12
                                                      Prob > F      =   0.0236
Total (centered) SS     =   7774.50641                Centered R2   =   0.8154
Total (uncentered) SS   =   7774.50641                Uncentered R2 =        .
Residual SS             =  8055.262357                Root MSE      =      .84

------------------------------------------------------------------------------
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       T_hat |   .2084479    .092081     2.26   0.024     .0279534    .3889425
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):         320.195
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              321.213
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         T_hat
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
---------------------------------------------------------------+
 Absorbed FE |  Num. Coefs.  =   Categories  -   Redundant     |
-------------+-------------------------------------------------|
     state_n |           50             50              0      |
     monthly |          233            234              1      |
---------------------------------------------------------------+

.
.
. *Manovskii regression 1, two-way clustered standard errors
. reghdfe u_revised (T_hat=u_error) if baseline, absorb(state_n monthly) cluster(state_n monthly)
(converged in 3 iterations)

HDFE IV (2SLS) estimation
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Estimates efficient for homoskedasticity only
```

```
Statistics robust to heteroskedasticity and clustering on state_n and monthly

Number of clusters (state_n) =      50                 Number of obs =    11700
Number of clusters (monthly) =     234                 F(  1,    49) =     0.37
                                                       Prob > F      =   0.5484
Total (centered) SS     =   7774.50641                 Centered R2   =   0.8154
Total (uncentered) SS   =   7774.50641                 Uncentered R2 =        .
Residual SS             =  8055.262357                 Root MSE      =      .84

------------------------------------------------------------------------------
             |               Robust
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       T_hat |   .2084479   .3449189     0.60   0.548    -.4846925    .9015884
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             13.984
                                                   Chi-sq(1) P-val =    0.0002
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              329.176
                         (Kleibergen-Paap rk Wald F statistic):         26.188
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         T_hat
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs.  =   Categories  -   Redundant     |
-------------+---------------------------------------|
     state_n |            0              50           50 *    |
     monthly |            0             234          234 *    |
-----------------------------------------------------+
* = fixed effect nested within cluster; treated as redundant for DoF computation

.
.
. *Manovskii regression 2, homoskedastic standard errors
. eststo: reghdfe u_revised (T=u_error) if baseline, absorb(state_n monthly)
(converged in 3 iterations)

HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                       Number of obs =    11700
                                                       F(  1, 11416) =     6.37
                                                       Prob > F      =   0.0116
Total (centered) SS     =   7774.50641                 Centered R2   =   0.8514
Total (uncentered) SS   =   7774.50641                 Uncentered R2 =        .
Residual SS             =  6484.603535                 Root MSE      =    .7537

------------------------------------------------------------------------------
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           T |   .1314704   .0521077     2.52   0.012     .0293303    .2336104
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):         102.619
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              101.014
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
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```
Instrumented:        T
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs. =   Categories  -   Redundant     |
-------------+---------------------------------------|
     state_n |          50            50              0      |
     monthly |         233           234              1      |
-----------------------------------------------------+

(est1 stored)

.
.
. *Manovskii regression 2, two-way clustered standard errors
. eststo: reghdfe u_revised (T=u_error) if baseline, absorb(state_n monthly) cluster(state_n monthly)
(converged in 3 iterations)

HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and clustering on state_n and monthly

Number of clusters (state_n) =      50                Number of obs =    11700
Number of clusters (monthly) =     234                F(  1,    49) =     0.45
                                                      Prob > F      =   0.5063
Total (centered) SS     =   7774.50641                Centered R2   =   0.8514
Total (uncentered) SS   =   7774.50641                Uncentered R2 =        .
Residual SS             =  6484.603535                Root MSE      =    .7537

------------------------------------------------------------------------------
             |               Robust
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           T |   .1314704   .1963737     0.67   0.506    -.2631574    .5260982
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):              9.720
                                                   Chi-sq(1) P-val =    0.0018
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              103.518
                         (Kleibergen-Paap rk Wald F statistic):         13.873
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:        T
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs. =   Categories  -   Redundant     |
-------------+---------------------------------------|
     state_n |           0            50             50 *    |
     monthly |           0           234            234 *    |
-----------------------------------------------------+
* = fixed effect nested within cluster; treated as redundant for DoF computation
(est2 stored)

.
.
. *Manovskii regression 2, one-way clustered standard errors
. eststo: reghdfe u_revised (T=u_error) if baseline, absorb(state_n monthly) cluster(state_n)
(converged in 3 iterations)

HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and clustering on state_n

Number of clusters (state_n) =      50                Number of obs =    11700
                                                      F(  1,    49) =     0.44
                                                      Prob > F      =   0.5112
```

```
Total (centered) SS     =   7774.50641              Centered R2   =   0.8514
Total (uncentered) SS   =   7774.50641              Uncentered R2 =        .
Residual SS             =  6484.603535              Root MSE      =    .7537

------------------------------------------------------------------------------
             |               Robust
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           T |   .1314704   .1986553     0.66   0.511    -.2677425    .5306832
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):             11.069
                                                   Chi-sq(1) P-val =    0.0009
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              101.457
                         (Kleibergen-Paap rk Wald F statistic):         14.030
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         T
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs.  =   Categories  -   Redundant  |
-------------+---------------------------------------|
     state_n |           0              50            50 *  |
     monthly |         233             234             1    |
-----------------------------------------------------+
* = fixed effect nested within cluster; treated as redundant for DoF computation
(est3 stored)

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. *Manovskii regression 3, homoskedastic standard errors
. reghdfe u_revised (epsilon=u_error) if baseline, absorb(state_n monthly)
(converged in 3 iterations)
HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only
                                                      Number of obs =    11550
                                                      F(  1, 11269) =     4.35
                                                      Prob > F      =   0.0370
Total (centered) SS     =  7598.947217                Centered R2   =   0.8104
Total (uncentered) SS   =  7598.947217                Uncentered R2 =        .
Residual SS             =  8022.840799                Root MSE      =    .8438

------------------------------------------------------------------------------
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     epsilon |   .5729452   .2746375     2.09   0.037     .0346079    1.111283
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):          87.168
                                                   Chi-sq(1) P-val =    0.0000
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               85.694
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         epsilon
Excluded instruments: u_error
------------------------------------------------------------------------------
```

```
Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs.  =   Categories  -   Redundant     |
-------------+---------------------------------------|
     state_n |           50            50             0     |
     monthly |          230           231             1     |
-----------------------------------------------------+

.
.
. *Manovskii regression 3, two-way clustered standard errors
. reghdfe u_revised (epsilon=u_error) if baseline, absorb(state_n monthly) cluster(state_n monthly)
(converged in 3 iterations)
HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and clustering on state_n and monthly
Number of clusters (state_n) =      50                Number of obs =    11550
Number of clusters (monthly) =     231                F(  1,    49) =     0.35
                                                      Prob > F      =   0.5595
Total (centered) SS     =  7598.947217                Centered R2   =   0.8104
Total (uncentered) SS   =  7598.947217                Uncentered R2 =        .
Residual SS             =  8022.840799                Root MSE      =    .8438
------------------------------------------------------------------------------
             |               Robust
   u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     epsilon |   .5729452   .9749765     0.59   0.559    -1.386343    2.532234
------------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):              9.843
                                                   Chi-sq(1) P-val =    0.0017
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):               87.823
                         (Kleibergen-Paap rk Wald F statistic):         16.371
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         epsilon
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs.  =   Categories  -   Redundant     |
-------------+---------------------------------------|
     state_n |            0            50            50 *   |
     monthly |            0           231           231 *   |
-----------------------------------------------------+
* = fixed effect nested within cluster; treated as redundant for DoF computation
.
.
. *Manovskii regression 2, one lead of unemployment
. eststo: reghdfe F.u_revised (T=u_error) if baseline, absorb(state_n monthly) cluster(state_n monthly)
(converged in 3 iterations)
HDFE IV (2SLS) estimation
-------------------------

Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity and clustering on state_n and monthly
Number of clusters (state_n) =      50                Number of obs =    11650
Number of clusters (monthly) =     233                F(  1,    49) =     0.06
                                                      Prob > F      =   0.8027
Total (centered) SS     =  7744.934579                Centered R2   =   0.8051
Total (uncentered) SS   =  7744.934579                Uncentered R2 =        .
Residual SS             =  8500.464187                Root MSE      =    .8648
------------------------------------------------------------------------------
             |               Robust
```

```
F.u_revised |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------+----------------------------------------------------------------
          T |  -.0539041   .2145424    -0.25   0.803    -.4850433     .377235
-----------------------------------------------------------------------------
Underidentification test (Kleibergen-Paap rk LM statistic):              9.722
                                                   Chi-sq(1) P-val =    0.0018
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):              103.099
                         (Kleibergen-Paap rk Wald F statistic):         13.880
Stock-Yogo weak ID test critical values: 10% maximal IV size             16.38
                                         15% maximal IV size              8.96
                                         20% maximal IV size              6.66
                                         25% maximal IV size              5.53
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):         0.000
                                                 (equation exactly identified)
------------------------------------------------------------------------------
Instrumented:         T
Excluded instruments: u_error
------------------------------------------------------------------------------

Absorbed degrees of freedom:
-----------------------------------------------------+
 Absorbed FE | Num. Coefs.  =   Categories  -   Redundant  |
-------------+---------------------------------------|
     state_n |           0              50          50 *  |
     monthly |           0             233         233 *  |
-----------------------------------------------------+
* = fixed effect nested within cluster; treated as redundant for DoF computation
(est4 stored)

.
```