Reply to Hagedorn, Manovskii, and Mitman on "Interpreting Recent Quasi-Experimental Evidence on the Effects of Unemployment Benefit Extensions"

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In a new working paper (Chodorow-Reich and Karabarbounis, 2016, henceforth CRK), we presented novel evidence showing the limited influence of unemployment benefit extensions on state-level macroeconomic outcomes such as unemployment, vacancies, employment, and wages. We welcome comments on our paper and have facilitated the exploration of our results by other researchers by making the dataset that underlies our analysis available on our webpages.

In a recent comment, Hagedorn, Manovskii, and Mitman (2016, henceforth HMM) use our dataset to criticize the evidence presented in CRK. The HMM criticism focuses on two aspects of our work. We show that their first criticism does not apply to the empirical framework actually implemented in CRK. Their second criticism is already answered by the exercise we conduct in Section 4 of CRK and which receives no mention in HMM.

We first summarize our responses to the HMM criticisms and then present our arguments in more detail.

HMM criticism 1. The CRK approach fails to overcome the endogeneity of UI benefit extensions to macroeconomic conditions.

Reply to criticism 1. The largest part of the HMM comment on our work amounts to criticizing an empirical framework and regression specification that CRK *do not use.* Had they considered the actual framework in our paper, they would not have found a mechanical correlation between the component of the UI benefit extensions that CRK focus on and macroeconomic outcomes. We repeat the placebo test proposed by HMM and find that it fails to produce any effect of extending UI benefits on unemployment if we perform this test with the regressor actually used in the CRK analysis. We conclude that properly applying the placebo test proposed by HMM *strengthens* the validity of our results.

HMM criticism 2. The CRK approach fails to address the role of expectations. HMM recommend that researchers impose more structure in order to infer the role of expectations by forward looking individuals for labor market outcomes.

Reply to criticism 2. Section 4 of CRK addresses the role of expectations. There, we impose the additional structure required to make our empirical results informative for the effects of UI policy generally when expectations about the future policies affect equilibrium outcomes. The structure CRK imposes is the standard DMP framework (Diamond, 1982; Mortensen and Pissarides, 1994) that HMM have also used in numerous previous occasions. The role of expectations for labor market outcomes in our model is identical to that in their own work (Hagedorn and Manovskii, 2008; Mitman and Rabinovich, 2014; Hagedorn, Karahan, Manovskii, and Mitman, 2015). We are puzzled by HMM's disregard of this part of our paper.

1 Endogeneity of Benefit Extensions

The key challenge in identifying the effect of UI benefit extensions on macroeconomic outcomes is that benefits are extended in times of elevated unemployment. This simultaneity happens both because U.S. law makes benefit extensions a function of the state unemployment rate and because policymakers enact emergency compensation in recessions. The plausibility of any empirical study of the effects of UI on macroeconomic outcomes rests on whether it successfully resolves this identification challenge. HMM question the success of CRK in resolving this challenge, but do so by criticizing a regression we do not actually run. The approach we actually follow does not suffer from their criticism.

1.1 CRK Framework

We begin by summarizing the CRK strategy for overcoming the endogeneity of UI benefit extensions to macroeconomic conditions. First, we use data revisions to isolate the component of benefit extensions arising from mismeasurement of state unemployment rates in real time. Denoting by $T_{s,t}$ the duration of UI benefits under the real-time unemployment rate $u_{s,t}^{\text{real-time}}$ in state s at time t and by $\tilde{T}_{s,t}$ the duration of UI benefits under the revised unemployment rate $u_{s,t}^{\text{revised}}$, we write:

$$T_{s,t} = \tilde{T}_{s,t} + \hat{T}_{s,t}, \tag{1}$$

where $\hat{T}_{s,t}$ is the UI error. Variation in the actual duration of benefit extensions $T_{s,t}$ comes from the component $\tilde{T}_{s,t}$ which depends on true economic fundamentals (as measured by the revised data) and from the component $\hat{T}_{s,t}$ which reflects measurement error in the state unemployment rate.

We find that the UI error $\hat{T}_{s,t}$ exhibits serial correlation. Similar in spirit to the approach used in the VAR and the business cycle literatures, we define the "UI error innovation" as the unexpected part of the UI error:

$$\epsilon_{s,t} = \hat{T}_{s,t} - \mathbb{E}_{t-1}\hat{T}_{s,t}, \tag{2}$$

where $\mathbb{E}_{t-1}\hat{T}_{s,t}$ denotes the expectation of $\hat{T}_{s,t}$ using information available until period $t-1$. In CRK we describe how we construct the expectation of the UI error $\mathbb{E}_{t-1}\hat{T}_{s,t}$ which, in turn, allows us to identify the unexpected component in the UI error $\epsilon_{s,t}$ from equation (2).

The CRK approach is to measure the response of labor market variables $y_{s,t+h}$ at horizon h to a one-month UI error innovation $\epsilon_{s,t}$. Our baseline specification takes the form:

$$y_{s,t+h} = d_s + d_t + \beta(h)\epsilon_{s,t} + \nu_{s,t+h}, \tag{3}$$

where d_s denotes a state fixed effect and d_t denotes a month fixed effect. The identifying assumption in the CRK framework is that the innovation in the UI error $\epsilon_{s,t}$ is orthogonal to other influences of labor market outcomes $\nu_{s,t+h}$, conditional on state and month fixed effects. Intuitively, the CRK framework identifies the effects of unemployment benefit extensions on labor market outcomes by isolating for each month the component of benefit extensions caused by unpredictable measurement error in the real-time unemployment rate. We stress that this identifying assumption concerns the unexpected part of the UI error, what we call $\epsilon_{s,t}$, and not the UI error $\hat{T}_{s,t}$.

1.2 HMM Criticism

HMM criticize the CRK approach on the basis of a potential correlation between the UI error $\hat{T}_{s,t}$ and the error term $\nu_{s,t+h}$ in regression (3). HMM illustrate this with an example and a placebo test. The argument of HMM is not relevant because CRK never regress labor market outcomes $y_{s,t+h}$ on the UI error $\hat{T}_{s,t}$. We instead regress $y_{s,t+h}$ on serially uncorrelated innovations of the UI error $\epsilon_{s,t}$. HMM state, without explanation, that "Obviously, the same arguments apply and thus the same endogeneity problems arise with any innovation series as they do to the original series." We show that this statement is not correct using the example and the placebo test that HMM themselves propose.

HMM example. The HMM example assumes that there is only one unemployment rate threshold at 6%, so that the duration of benefits increases from 26 weeks to 39 weeks when the real-time unemployment rate crosses this threshold from below. The duration of benefits declines from 39 weeks to 26 weeks when the real-time unemployment rate crosses the 6% threshold from above. Depending on whether the revised and the real-time unemployment are above or below the threshold, we have four cases.

Case 1. $u_t^{\text{real-time}} < 6\%$, $u_t^{\text{revised}} < 6\%$, $T_t = 26$, $\tilde{T}_t = 26$, and $\hat{T}_t = 0$.

Case 2. $u_t^{\text{real-time}} > 6\%$, $u_t^{\text{revised}} < 6\%$, $T_t = 39$, $\tilde{T}_t = 26$, and $\hat{T}_t = 13$.

Case 3. $u_t^{\text{real-time}} < 6\%$, $u_t^{\text{revised}} > 6\%$, $T_t = 26$, $\tilde{T}_t = 39$, and $\hat{T}_t = -13$.

Case 4. $u_t^{\text{real-time}} > 6\%$, $u_t^{\text{revised}} > 6\%$, $T_t = 39$, $\tilde{T}_t = 39$, and $\hat{T}_t = 0$.

In this example, $\mathbb{E}\left[\hat{T}_t | u_t^{\text{revised}} < 6\right] > 0$ and $\mathbb{E}\left[\hat{T}_t | u_t^{\text{revised}} > 6\right] < 0$. Therefore, as HMM note, there is a negative relationship between the average value of the UI error $\hat{T}_t$ and the revised unemployment rate u_t^{revised}.

However, the CRK regression in (3) does not use $\hat{T}_{s,t}$ as the right-hand variable. It uses the innovation $\epsilon_{s,t}$. This difference is crucial. We defined the innovation in equation (2) as the unforecastable component of $\hat{T}_{s,t}$ using information available as of period $t-1$. Given this definition, it does not follow that "the same endogeneity problems arise with any innovation series as they do to the original series" as stated by HMM.

We illustrate this with a simple counterexample. If $\epsilon_{s,t}$ is the $t-1$ forecast error of $\hat{T}_{s,t}$, then it must be uncorrelated with information available at time $t-1$. In the standard DMP model used in CRK and in a number of papers by HMM, the unemployment rate for period t is already known at time $t-1$.[1] Therefore, even though the correlation between the UI error $\hat{T}_{s,t}$ and the unemployment rate $u_{s,t}^{\text{revised}}$ could be negative in the DMP model, the correlation between the innovation $\epsilon_{s,t}$ and $u_{s,t}^{\text{revised}}$ is zero.[2]

To be clear, the preceding counterexample is not meant to be a validation of our identification assumption based on the particular timing of the standard DMP model. It simply shows that the discussion in HMM of $\hat{T}_{s,t}$ cannot invalidate the CRK approach because, even if one constructs examples where the UI error $\hat{T}_{s,t}$ is mechanically correlated with the revised unemployment rate, the innovation in the UI error $\epsilon_{s,t}$ can still be uncorrelated with the revised unemployment rate by construction. Since we use $\epsilon_{s,t}$ and not $\hat{T}_{s,t}$ in our regressions, the HMM example is not relevant in evaluating the CRK methodology.[3]

[1] The law of motion for unemployment is $u_t = s_{t-1}(1-u_{t-1}) + f_{t-1}u_{t-1}$, where s_{t-1} denotes the separation rate and f_{t-1} is the job finding rate. Knowledge of these equilibrium outcomes implies that agents know u_t at period $t-1$.

[2] Jump variables such as vacancies may respond in period t to the contemporaneous innovation, affecting the unemployment rate starting in $t+1$.

[3] In CRK, we do not condition the forecast $\mathbb{E}_{t-1}\hat{T}_{s,t}$ on time t variables such as $u_{s,t}^{\text{revised}}$ because actual UI policy makes benefit extensions a function of lagged rather than contemporaneous unemployment (the real-time unemployment rate for month t is not announced until around the 20th day of month $t+1$). Therefore, even if $u_{s,t}^{\text{revised}}$ is not known at time $t-1$, the forecast error of the unemployment rate $u_{s,t}^{\text{revised}} - \mathbb{E}_{t-1}u_{s,t}^{\text{revised}}$ can also be uncorrelated with $\epsilon_{s,t}$ because $\epsilon_{s,t}$ is pre-determined (but not yet known) as of time $t-1$.

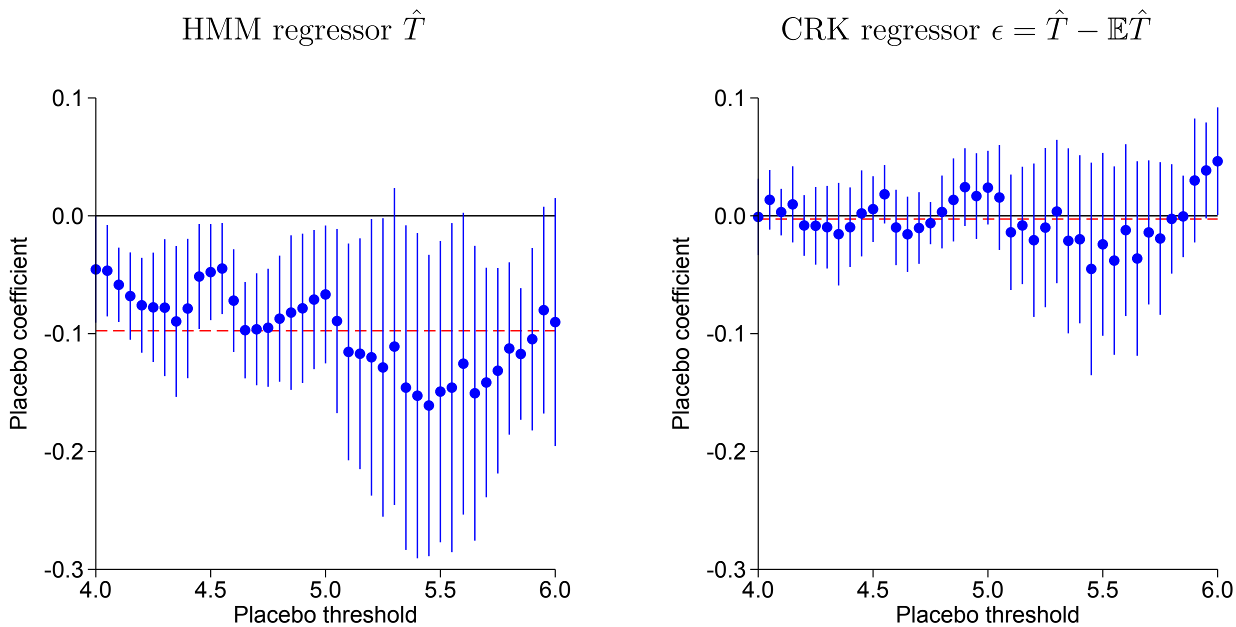
Given our discussion about the difference between the UI error $\hat{T}_{s,t}$ and the innovation $\epsilon_{s,t}$, it is now easy to understand the CA and NV paths of $\hat{T}_{s,t}$ and $\epsilon_{s,t}$ that HMM reported from our data as their Figure 4. At any particular unemployment rate and benefit extension schedule, we may have $\mathbb{E}_t\left(\hat{T}_{s,t+1}\right) \neq 0$ despite the contemporaneous $\hat{T}_{s,t} = 0$. Since the forecast depends on the unemployment rate and benefit schedule, the magnitude of these innovations will change over time. This explains why there are non-zero and non-constant innovations despite no realizations of $\hat{T}_{s,t} \neq 0$. However, the innovations shown are small. The maximum absolute innovation shown in HMM Figure 4 is 0.10, while the standard deviation of an innovation conditional on a change in $\hat{T}$ is 1.43. The small magnitude reflects the fact that, while the UI error does not have exactly a zero mean always, in practice the mean UI error is pretty close to zero.

HMM placebo test. We now revisit the placebo test that HMM use to argue that the CRK approach is not appropriate because there is a mechanical negative correlation between the (revised) unemployment rate and the UI error $\hat{T}_{s,t}$. The idea of their exercise is to consider the effect of a hypothetical trigger of benefit extensions in data during 1996-2000, a period when almost no actual extensions took place.[4] HMM consider individual placebo trigger thresholds τ in 0.05 percentage point increments of the unemployment rate from 4% to 6%. Using our data, they then construct the artificial series $T_{s,t}(\tau)$ and $\tilde{T}_{s,t}(\tau)$ based on whether the lagging three month moving average of the real-time or revised unemployment rate exceeds the threshold τ. Conditional on exceeding the threshold, they set $T_{s,t}(\tau) = 1.75$ and $\tilde{T}_{s,t}(\tau) = 1.75$ months. Given that there were almost no actual extensions of benefits during that period, a valid research design should uncover no effect of these placebo extensions on the unemployment rate.

Unfortunately, HMM again use the wrong regressor for their placebo exercise. To illustrate the problem, the left panel of Figure 1 replicates the HMM exercise (Figure 5 of their comment) which regresses the revised unemployment rate on $\hat{T}_{s,t}(\tau)$ for every threshold τ. The red dashed line denotes the average of the estimated coefficients across all τ. Clearly, all coefficients are

[4] During that period New Jersey experienced a temporary extended benefits period as the result of a state program, while Alaska triggered onto the state-federal Extended Benefits program.

Figure 1: Placebo Test Revisited



Notes: The left panel replicates figure 5 in HKM. The right panel repeats the same placebo exercise but for the actual regression specification used in CRK. The difference between the two exercises is whether the key right hand side variable in the regression is the level of the UI error (left panel) or the innovation in the UI error (right panel). The dashed red line indicates the empirical mean of the placebo coefficients. The whiskers denote the 95% confidence interval for each coefficient based on two-way clustered standard errors on state and month.

negative and most are statistically significant.

The right panel of Figure 1 implements the placebo test for the regression actually used in CRK, which has the innovation $\epsilon_{s,t}$ in the right-hand side.[5] Here the average coefficient is essentially zero and only one out of the 41 coefficients turns out to be statistically significant (and barely so). We conclude that the placebo test proposed by HMM *strengthens* the validity of our results once the correct version of the CRK regression is used to perform the test.

1.3 Further HMM Comments on the Empirical Approach in CRK

We conclude by replying to two additional comments by HMM. First, HMM argue that "The econometrician has to make arbitrary choices about agents' information sets and their forecast-

[5] The construction of $\epsilon_{s,t}$ for this exercise mirrors the approach taken in CRK. We first construct first order Markov transition probabilities $\pi_T\left(\hat{T}_{s,t+1} = x_j | \hat{T}_{s,t} = x_i; u^{\text{revised}}_{s,t}\right)$ for a discretization of the space of possible values $\{\hat{T}_{s,t}\}$ and the state space $\{u^{\text{revised}}_{s,t}\}$. For this placebo exercise, we let the values $x_j \in \{-1.75, 0, 1.75\}$ and construct separate Markov transition matrices for $u^{\text{revised}}_{s,t} < \tau$ and $u^{\text{revised}}_{s,t} \geq \tau$. Given these probabilities, we calculate $\mathbb{E}_{t-1}\hat{T}_{s,t}(\tau)$ and form the innovation as $\epsilon_{s,t}(\tau) = \hat{T}_{s,t}(\tau) - \mathbb{E}_{t-1}\hat{T}_{s,t}(\tau)$.

ing procedure, which are almost certainly not correctly reflecting how agents forecast, so that innovations depend on past variables such as the unemployment rate." However, our robustness checks in Table 5 and the predictability results in Table 6 of our paper show that the innovations are essentially uncorrelated with past data such as the unemployment rate.

Second, HMM argue that it "is unclear which behavior of unemployment or other macro variables ... are causing movements in innovations but it is clear that these are erroneous movements not reflecting error in benefits. Clearly, one would expect that regressing unemployment on noise yields a coefficient of around zero." Hopefully our discussion above has clarified the behavior of innovations. Our paper also contains discussion of the possibility of attenuation bias. Most important, we find that the fraction of unemployed claiming UI benefits responds to the UI error innovations. If the innovations were just noise, we would not observe more unemployed claiming benefits following these innovations.

2 The Role of Expectations

The second criticism of the CRK approach is that it fails to address the role of expectations. We agree with HMM that expectations of future benefits and of other macroeconomic variables are important in the vacancy creation decision of firms. Indeed, we are quite careful in interpreting our results to take account of the persistence of the UI error process $\hat{T}$ and how it may differ from the persistence of the systematic component $\tilde{T}$.

How to interpret the impulse response functions. Our empirical results show the response of state-level macroeconomic variables such as unemployment to an innovation in the UI error. Embedded in these responses are agents' expectations of the persistence of the UI error. In Figure 2 we reproduce Figure 2 in CRK that shows the response of $\epsilon_{s,t+h}$ and $\hat{T}_{s,t+h}$ for various horizons $t+h$ to a one-month impulse in the innovation $\epsilon_{s,t}$ at time t. As the figure makes clear, while the innovations exhibit essentially no serial correlation, the UI error is a persistent process and so an innovation to the process does not immediately die out. Since forward-looking

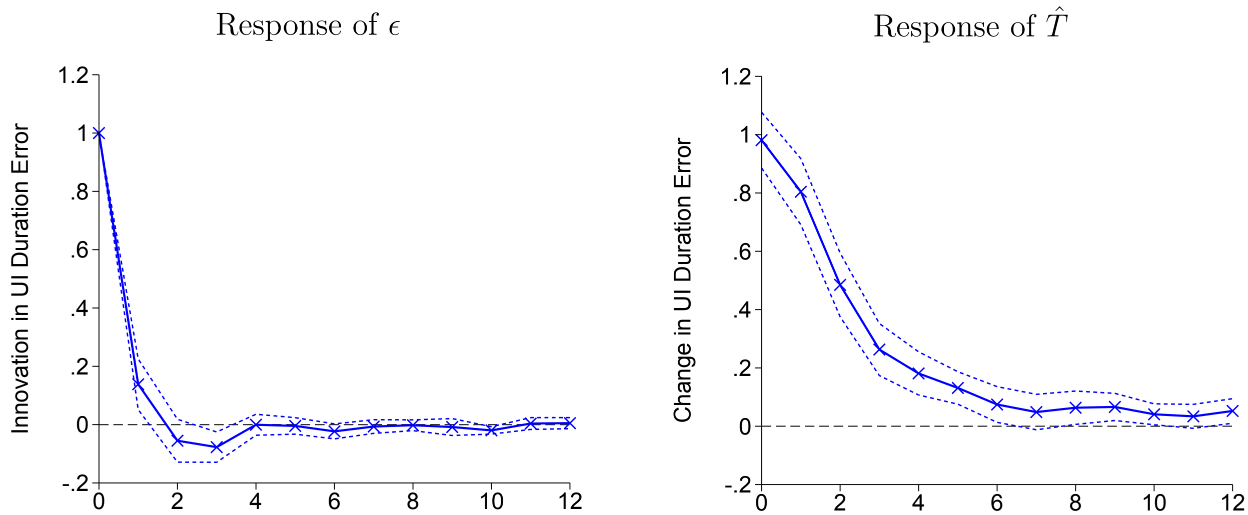


Figure 2: Serial Correlation

Notes: The figure plots the coefficients on $\epsilon_{s,t}$ from the regressions $\epsilon_{s,t+h} = \beta(h)\epsilon_{s,t} + d_s(h) + d_t(h) + \nu_{s,t+h}$ and $\hat{T}_{s,t+h} = \beta(h)\epsilon_{s,t} + d_s(h) + d_t(h) + \nu_{s,t+h}$. The dashed lines denote the 90 percent confidence interval based on two-way clustered standard errors.

individuals will take into account the expected path of $\hat{T}_{s,t}$ in response to an innovation shown in the left panel of Figure 2, the impulse response functions we estimate incorporate agents' expectations of future benefits. Therefore, the statement in HMM that "the measurement approach in CRK also does not take into account that expectations of the full sequence of future expected benefits matter for forward-looking decision makers" is not true.

Informativeness for the effect of extensions during the Great Recession. In various places in CRK (see e.g. pp. 4, 21, 29) we make the point that the persistence of a typical UI error differs from the persistence observed in the extension of benefits during the Great Recession. Section 4 of CRK shows how our empirical results are informative for a more persistent extension of benefits. There we follow the direction that HMM recommend and impose additional structure that takes into account how expectations of future policies and other macroeconomic variables affect current labor market outcomes. The particular structure we impose is a variant of the standard DMP model, a model that HMM also use in their own work (Hagedorn and Manovskii, 2008; Mitman and Rabinovich, 2014; Hagedorn, Karahan, Manovskii, and Mitman, 2015).

Our approach treats the empirical response from regression (3) as an informative moment within the DMP structure. Specifically, CRK show that:

1. Under the calibration of Hagedorn and Manovskii (2008) and Mitman and Rabinovich (2014) with a high opportunity cost of benefits b, the DMP model implies a large response of unemployment to a one-month innovation in the UI error. Correspondingly, the DMP model implies large unemployment effects of extending benefits in a recession from 6 to 20 months.

2. Under the calibration of Chodorow-Reich and Karabarbounis (2015) with a low opportunity cost of benefits b, the DMP model implies a small response of unemployment to a one-month innovation in the UI error. Correspondingly, the DMP model implies small unemployment effects of extending benefits in a recession from 6 to 20 months.

In the data we estimate a small (statistically insignificant) response of unemployment to a UI error innovation. The same structure that HMM use, which takes into account expectations about the future path of benefits, then implies a limited macroeconomic effect of extending benefits by as much as observed in the aftermath of the Great Recession.

3 Final Comments

Understanding the effects of UI benefit extensions on macroeconomic variables such as unemployment and employment matters for the design of policy and for our understanding of labor markets. We appreciate the role of previous work by HMM (Hagedorn, Karahan, Manovskii, and Mitman, 2015; Hagedorn, Manovskii, and Mitman, 2015) in pushing economists to study these issues empirically. Our paper is an attempt to shed further light on these questions. Like their work, we would like ours to be subject to critical examination. However, the end goal of such examination must be to improve or validate scholarship. In this case, the criticisms raised by HMM simply do not apply to our work.

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