Reply to James D. Hamilton’s Comment on “Are the Responses of the U.S. Economy Asymmetric in Energy Price Increases and Decreases?”

In his comment “Yes, the Response of the U.S. Economy to Energy Prices is Nonlinear”, James D. Hamilton states that the core disagreement in his view is whether an optimal forecast of real GDP growth would be a nonlinear function of past prices. Specifically, for him, this statement refers to the question of whether lags of the 3-year net oil price increase measure enter the reduced-form relationship between U.S. real GDP growth and the real price of oil.

We do not think that there actually is a reason for disagreement. Although our $p$-values are slightly larger, we agree with Hamilton in that we also reject the null of symmetry in the slopes at conventional significance levels for this particular specification. Given that we both reject this null hypothesis, this test result cannot be a source of disagreement.

Rather the key question is how to interpret the evidence from reduced-form models. Our paper’s objective is to determine the degree of asymmetry of the dynamic responses of real GDP to an innovation in the real price of oil. It is this impulse response function that has explicitly been the object of interest in most papers published on this topic since the 1990s. Our main point is that inspection of the reduced-form coefficients is neither necessary nor sufficient for judging the degree of asymmetry in the impulse response functions. This is an immediate consequence of the fact that the magnitude of the impulse responses (and hence the degree of asymmetry of the response function) in nonlinear models depends on the magnitude of the shock. This dependence on the magnitude of the oil price shock is not allowed for in conventional slope-based tests, making these tests inappropriate for the task of judging the degree of symmetry of the response functions.

Although it is true that the absence of any asymmetric terms in the reduced form would imply symmetric response functions, even small and insignificant asymmetries in the reduced form can cause large degrees of asymmetry in the response functions, given the nonlinearity of the mapping from reduced form slopes to impulse responses. Likewise, highly statistically significant rejections of symmetry in the slopes may be consistent with nearly symmetric response functions. The empirical results in Table 4 and Figure 10 of our paper illustrate that this point is not merely a theoretical possibility, but a likely outcome in practice.

To summarize, as far as U.S. real GDP is concerned, James Hamilton and we are in agreement that reduced-form asymmetries of the type considered by Mork (1989) are not supported by the data. We also agree that there is statistically significant evidence of asymmetries in the reduced form associated with 3-year net oil price increases.

Furthermore, Hamilton agrees with us that the impulse response results for censored oil price VAR models routinely reported in applied work since the 1990s are invalid, and that the econometric methods we proposed can be used to compute these impulse responses correctly.

Likewise, Hamilton does not take issue with our result that the estimated responses of U.S. real GDP to a positive one-standard deviation real oil price shock look symmetric, or that there is no
statistically significant evidence against the null hypothesis of symmetry in these response functions.

Given that we are in such broad agreement, how could we seem to draw such different conclusions? One difference apparently is what we mean by a “response”. Our use of the term response refers to a rather precisely defined statistical object building on Gallant et al. (1993) and Koop et al. (1996). Our definition of the (potentially nonlinear) response to oil price shocks is fully consistent with these papers. It refers to an impulse response function, not to nonzero values of lagged coefficient on net oil price increases in the reduced form. Moreover, Hamilton fully agrees with our conclusion that one cannot compute impulse response functions from the single-equation reduced-form model used to test the null of symmetric slopes, and he presented no evidence that would contradict our impulse response analysis. As such, we believe that the evidence supports our conclusion that “Yes, the Reduced Form Representation of U.S. Real GDP is Nonlinear in Real Oil Prices, but, no, the Responses of U.S. Real GDP to Real Oil Price Shocks are not Noticeably Asymmetric”.

Beyond language, the only real difference between our and Hamilton’s assessment of the evidence is one of emphasis. Hamilton conjectures that a parsimonious (and possibly misspecified) single-equation reduced-form model involving lagged net oil price increases may be useful in computing one-quarter-ahead out-of-sample forecasts of real GDP growth, even if it is not useful for computing estimates of impulse responses. This is an interesting suggestion that we are investigating in ongoing research, but that is not related to our current paper, which is squarely about impulse response analysis. In fact, none of the many applied papers we cite has been concerned with out-of-sample forecasting of real GDP. Instead these papers have been concerned with quantifying the response of real GDP to oil price shocks. Moreover, Hamilton is careful to make clear that his suggestion is only intended for one-quarter-ahead forecasts. He agrees that forecasters interested in longer horizons, will have to build on the methods proposed in our paper for the related, but distinct context of impulse response analysis.