

Reply to “Time is Not A Theoretical Variable”

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We thank Neal Beck for his comments. In general, there is little difference in our theoretical and practical positions. We all agree that in some applications, time dummies can be problematic; controlling for temporal dependence is important for less-biased estimation of the coefficients on our substantive regressors; a smoothed function of time (whether via a cubic polynomial or spline) is a useful way to model temporal dependence in grouped binary data; and viewing the graph of the hazard can be informative.

We do, however, want to clarify a few points raised by Beck. First, Beck asserts that we believe a cubic polynomial is “the best way to model duration dependence.” Beck also asserts that we find the cubic polynomial superior because it imposes no knot selection. In fact, we make no such claims in our article. Indeed, we note there that the cubic polynomial is an approximation and, importantly, a special case of cubic splines and their extensions. Moreover, like Beck, we believe that applying “art” (whether through further technical analysis or substantive knowledge) to knot selection can be beneficial. The problem we point out is that this can be a difficult process with binary data. Rather than following Beck’s advice in his present comments, most researchers use Beck, Katz, & Tucker (1998)’s application-specific knots. It is especially in this case that a cubic polynomial appears to be preferable—that is, a cubic spline with no knots may very well be preferable to a cubic spline with incorrectly specified knots. An automatic smoother, such as the one implemented in our article, makes this less onerous for the researcher. However, researchers should be careful in how they apply any smoothing technique, whether a cubic polynomial or splines.

Lastly, how seriously should we take “time”? From a theoretical perspective, dynamic choice models and repeated games take time (and the discount factor) quite seriously. From a statistical perspective, the time series and survival analysis literatures consider time as the central modeling concept. Indeed, many studies using survival analysis focus on estimating and interpreting hazards. That said, we note in our article and agree with Beck that in the context of grouped binary data, interpreting “the effect of time” should not be undertaken quite so literally. Time is not an independent actor here. Rather, the hazard reflects unmodeled processes and/or omitted regressors. We are concerned, however, that the take-away from Beck’s final comments will be that the hazard has nothing to say about one’s substantive topic. For most subfields, it will likely take numerous iterations of collecting new

data and constructing better models before modeling duration dependence becomes unnecessary. We encourage researchers to think about the hazard as a substantive part of the model that has not yet been explicitly specified via regressors or functional form. In that regard, it is an interesting and important component of one's present substantive research. Hopefully, examining the hazard will also provide clues for future research.

Again, our differences with Beck are slight. Given how well the cubic polynomial performs in a wide range of cases, coupled with its ease of implementation and interpretation, we believe substantive researchers will find it a useful tool for taking time seriously.