Asymmetric Dependence between Time and Event: Continuous or Ordered Event History Analysis Using Copula

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INTRODUCTION

Political scientists are interested in not just when an event happens but also what kind of event happens. Moreover, what happens is related to when it happens. Scholars usually use event history analysis to examine which factors affect when events happen. If events are classified into several discrete categories, researchers may employ competing risks models (Box-Steffensmeier and Jones, 2004; Gordon, 2002). But common methods of event history analysis cannot deal with continuous or ordered events, a lacuna which the current paper addresses.

For example, when will an election be called, and how many votes will the governing parties be likely to win? Smith (2004) argues that if the election is called earlier than expected, government wins even with fewer votes. Why? If the government anticipates bad news such as an economic recession, it will call elections earlier than planned. But, since voters rationally expect this, they also anticipate that something is wrong and fewer of them support the government in the voting booth. In this case, we cannot regress the vote rate on the election time because what matters is not the actual time of the election but its relative time against its expected time.

Another instance is the duration of warfare and the terms of peace. Slantchev (2004) maintains that, the longer wars last, the worse the terms of peace are for initiators. The

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original article employs the ordered probit model where an ordered war outcome is the dependent variable and the predicted duration of war is an independent variable. However, omitted variables may affect both the duration of war and the terms of peace and, therefore, estimates are likely to be biased.

To address the problem, the model of the present paper takes advantage of "copula" (which will be explained shortly) to model dependence between latent time and event variables. To be concrete, for example, the model assumes that the log of a duration variable (such as inter-election time) and an event variable (such as number of votes) follow the bivariate normal distribution. If duration is censored, survival probability is used as in typical event history analysis, ignoring the event variable. The quantity of the most interest, that is, the relationship between duration and the event, is captured by the covariance parameter, which is expected to be positive in this case.

Some readers may wonder about the cases where event variable or log of duration variable do not have the normal distribution. A merit of copula is that, whatever marginal distributions time and event variables follow, scholars can take into account dependence between the two. For example, duration may follow Weibull or log logistic distribution, while event may have beta, exponential, or Poisson distribution. Moreover, dependence between time and event is not limited to bivariate normal distributions. There are several kinds of copula functions. Thus, it is possible to study various kinds of dependence. This model enables scholars to study the relationship between time of events and contents of events, which is an important and promising topic in political science.

Aside from modularity and flexibility, another merit of copula is its ability to capture asymmetric dependence (or local dependence). For example, Slantchev (2004, 813) states "[l]ong wars are expected to end badly for the initiator." Carefully, he does *not* add "vice versa" (see also his Hypothesis 2 (p. 816)). Short wars may end either well or badly for the initiator.

Through reanalysis, this paper intends to contribite to international relation studies. Slantchev (2004, 813-14) maintains that "[i]nformation acquired while fighting outweighs information available prior to the war. ... prewar military indicators may be poor predictors of outcome." This paper will show that not only predicted duration of war he uses but also unexpected error term of war duration has negative impact on war outcome.

The organization of the paper is as follows. The first section deals with continuous event, while the second section considers ordered event.