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Bandwagon Competition or Duration Dependence? Comment on 'Shaping Policy Diffusion'

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Ito (2001) has made an interesting argument on policy making in Japanese local governments. However, his analysis is based on the estimates from the models that do not properly take into account the temporal dependence of regional law adoption. The purpose of this comment is to point out a troubling aspect of Ito's event history modeling, and to put the existence of potential problems caused by temporally dependent observations into perspective.

How long does it take for a local government to adopt a regional law? This is the question that researchers share in the studies of policy diffusion, and is typically dealt with via a discrete-time model of whether or not a local government makes a decision in some time interval (usually a year). In analyzing the policy diffusion among Japanese prefectures, Ito compares the estimates regarding four regional laws, and argues that there are two sources of influence on regional law adoption: intervention by the national government and competition among local governments.

In diffusion studies, the logistic specification is commonly used to model the dichotomous variable of a local government adopting a regional law or of the law being not-yet-adopted. Event history analysis asks how the duration spent in one state affects the probability that a subject will make a transition to another state. For instance, we may ask how long a patient can survive. Any patients who have died are no longer in the state of surviving, and thus event history analysts focus on the instantaneous probability that a transition will occur at any given time, provided the subject has remained in the original state until that time. In a discrete-time model, temporal dummy variables mark the length of the sequence of zeros that precede the time interval in question, accounting for the temporal dependence of an event of interest.[1]

Following the diffusion study tradition, Ito estimates the logistic specification of

[1] Although a discrete-time equivalent to Cox proportional hazards model is a complementary log-log link, the more familiar logistic specification is commonly used.

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regional law adoption, which includes temporal dummies in addition to other explanatory variables. One of the key hypotheses is what he calls 'bandwagon competition'. In his view, local governments adopt a regional law for fear of being left behind. The probability of regional law adoption is expected to increase, as the number of local governments that have adopted the law increases. To test this hypothesis at the national level, Ito defines NATIONAL TOTAL ADOPTION as the cumulative number of adopters in the nation by the preceding year.

NATIONAL TOTAL ADOPTION is problematic for at least two reasons. First, this variable is measured at the system level, and varies by time but not across units. Such a 'systemic level variable' induces multicollinearity if the model also includes the temporal dummies that account for the duration dependence of an event of interest.[2] To avoid the problem of collinearity, Ito estimates the models that arbitrarily exclude some of the temporal dummies.[3] His analysis is thus based on the estimates of models that imperfectly account for the temporal dependence of an event of interest. Temporal dummies should not be included in the specification if regional law adoption is in fact temporally independent. Otherwise, the models should include all of the temporal dummies.

Secondly, NATIONAL TOTAL ADOPTION cannot be a measurement of a 'bandwagon competition' that is assumed to affect the instantaneous probability of regional law adoption independent of duration dependence, since it is a systemic level variable that irreversibly increases with duration time. Moreover, NATIONAL TOTAL ADOPTION is endogenously related to the function that a local government remains in the state of being not-yet-adopted. To illustrate the point, consider the case of the Citizens with Disabilities Act (CDA). The sample consists of 47 regional governments, and those were observed for a maximum of six years. The event of interest is the adoption of CDA by regional governments. Table 1 shows the number of regional governments that adopted CDA in each of the six years.[4]

Suppose that the instantaneous probability of an event of interest to occur, which is called the hazard rate in event history analysis, varies by year but is the same for all regional governments in each year. We can get estimates of the hazard rate by dividing the number of adopting governments by the number of governments that have not adopted CDA. In the first year, two governments adopted CDA, and thus the estimated hazard is $2/47 = 0.043$. Similarly, 12 governments adopted CDA out of 42 $(= 47-2-1-2)$ that are at risk of adopting CDA in the fourth year. The estimated hazard is $12/42 = 0.286$. An increase in NATIONAL TOTAL ADOPTION, which defines the number of regional governments that are at risk of adopting CDA, inevitably raises the instantaneous probability of adopting CDA for any of the

[2] Beck, Katz, and Tucker (1998, 1273).

[3] See also Ito (2002, 315, endnote 350). Although he refers to Beck *et al.* (1998) to justify his solution, it is not clear how his solution can be derived from their discussion on the issues concerning 'systemic level variables'.

[4] Data are from Ito (2002, 293).

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Table 1 *Distribution of Year of CDA Adoption*

Year	Number of Adopting Governments	Number at Risk	Estimated Hazard Rate	NATIONAL TOTAL ADOPTION	Reciprocal of Number at Risk
92	2	47	0.043	0	0.021
93	1	45	0.022	2	0.022
94	2	44	0.045	3	0.023
95	12	42	0.286	5	0.024
96	11	30	0.367	17	0.033
97	6	19	0.316	28	0.053

governments that have not adopted CDA, as shown in the last column of Table 1. NATIONAL TOTAL ADOPTION is thus endogenous to the instantaneous probability of regional law adoption, and should be distinguished from the presumed psychological effect of 'bandwagon competition,' which is assumed to be an exogenous factor affecting the probability of regional law adoption independent of duration dependence.[5]

Table 2 reports the re-estimates of the logistic specification of the four regional laws. These models do not include any exogenous variables but do include all of the temporal dummies for the years in which at least one regional government adopted the law in question.[6] The existence of duration dependence can be checked with a standard likelihood ratio test of the hypothesis that the estimates for the temporal dummies are equal to zero. For instance, the log-likelihood of the estimate is -116.44 for the case of the Freedom of Information Act (FOIA) and is -140.36 without the temporal dummies is. A chi-square statistic of 47.83 (13 degrees of freedom) clearly indicates that we should reject the null-hypothesis. Thus, the temporal dummies should be included in the specification, and there is no *a priori* reason that duration dependence can be either ignored or parametrically mimicked by NATIONAL TOTAL ADOPTION. The estimates for the temporal dummies are mostly positive and statistically significant except for the early 1990s. As shown in Figure 1, the predicted hazard rate of FOIA adoption increases in the second half of the 1980s and increases precipitously in the mid-1990s. Other two cases, the Environmental Policy Act (EPA) and CDA, also show the predicted hazard increasing precipitously in the

[5] Since NATIONAL TOTAL ADOPTION is a systemic level variable, it must have no cross-unit effect on the instantaneous probability of regional law adoption at any given time. If there is no duration dependence, some systemic level variables might be included to account for the difference in the instantaneous probability of regional law adoption over duration time. However, NATIONAL TOTAL ADOPTION is not such a systemic level variable, but increases with duration time, and thus its effect cannot be distinguished from duration dependence. In other words, NATIONAL TOTAL ADOPTION is a systemic level variable that has no effect on the instantaneous probability of regional law adoption unless there is duration dependence.

[6] To be precise, the specification includes a constant term and drops a temporal dummy for the first year in the data set.

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Table 2 *Estimates for Logistic Specification of Regional Law Adoption*

	FOIA		EPA		EIAA		CDA	
Year	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Const.	−4.19	0.71	−5.21	1.00	−5.23	1.00	−3.11	0.72
78					2.16	1.24		
79					2.21	1.24		
80					3.01	1.13		
81					2.37	1.24		
82					1.70	1.43		
83					2.46	1.24		
84	1.55	0.93			2.52	1.24		
86	3.27	0.79			1.86	1.43		
87	2.32	0.89						
88	2.75	0.87						
89	2.40	0.95			2.63	1.24		
90	2.94	0.91			3.48	1.14		
91	1.62	1.26			4.60	1.09		
92	1.70	1.26			4.83	1.13		
93	1.79	1.26					−0.67	1.24
94	3.63	0.95	2.55	1.17	3.98	1.28	0.07	1.02
95	3.27	1.10	4.49	1.05	3.44	1.47	2.20	0.80
96	3.78	1.16	5.42	1.07	3.62	1.49	2.57	0.82
97	4.88	1.42	4.74	1.15	3.84	1.50	2.34	0.88
LL_t	−116.44		−73.05		−123.81		−77.89	
LL_c	−140.36		−118.08		−152.62		−95.87	
# Obs.	381		316		606		227	

LL_t: Log-likelihood of the estimate with the temporal dummies.
LL_c: Log-likelihood of the estimate without the temporal dummies.

mid-1990s. On the other hand, the predicted hazard for the Environmental Impact Assessment Act (EIAA) reaches its highest level in the early 1990s, implying that there is a non-monotone relationship between the hazard rate and duration time. For all these cases, a likelihood ratio test indicates that we should reject the hypothesis of no duration dependence.[7]

In short, we are unable to appreciate Ito's finding since it critically depends on the estimates for NATIONAL TOTAL ADOPTION and thus the modeling technique used in his analyses. To account properly for the duration dependence of regional law adoption, I think that Ito should re-estimate the models that include all the temporal dummies and plausible explanatory variables but NATIONAL TOTAL ADOPTION. If NATIONAL TOTAL ADOPTION more or less explains the temporal dependence of regional law adoption in Ito's models, then the temporal dummies

[7] Cf. Ito (2001, 228, footnote 15).

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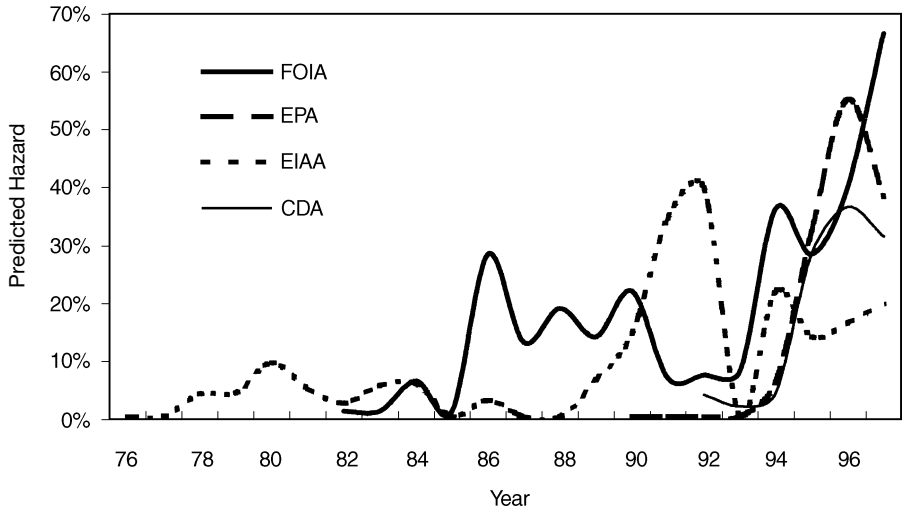


Figure 1 Duration Dependence of Regional Law Adoption

will do the same and the estimates for other explanatory variables would remain substantially the same in the correct models.[8]

References

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[8] Even without including NATIONAL TOTAL ADOPTION, Ito may conduct a test of the 'bandwagon' hypothesis by checking if the estimated coefficients for the temporal dummies are ever increasing as duration time gets longer. This is a more flexible test than one assuming that a unit increase affects the likelihood of regional law adoption in the same way at any value of NATIONAL TOTAL ADOPTION. In general, we may choose to ignore duration dependence if it is not serious, and include some substantially important systemic level variables. However, it is no longer an event history analysis if one chooses to include a systemic level variable and ignore serious duration dependence.

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