Online Appendix for "Complex survival: institutional overlap and the different forms of international organization termination"

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Contents

Introduction to the Online Appendix

This document contains supplementary materials for my paper "Complex survival: institutional overlap and the different forms of international organization termination."

It includes additional analyses, robustness checks, and detailed methodological discussions that complement the main paper.

Discussion on survival analysis and competing risks

Here, I present a brief explanation of the quantities of interest in survival analysis and competing risks analysis. For political science, Box-Steffensmeier and Jones (2004) remains the most relevant introduction. Recently, Flores (2022) published a new guide on survival analysis for social scientists.[1] His book is a very important contribution to this area, bringing to political science some of the advances in survival analysis that occurred in the two-decade interval between his book and Box-Steffensmeier and Jones'.

To elaborate my explanation below on competing risks analysis, I build upon the works of Austin et al. (2016), Flores (2022), Geskus (2024), Kalbfleisch and Schaubel (2023), Latouche et al. (2013), Putter et al. (2007), Putter et al. (Putter et al., 2020), and Therneau et al. (2024). For better flow in the explanation of these issues, I chose to explicitly mention their works here rather than in the body of the text. All analyses and explanations come from these works.

One of the most important quantities of interest in survival analysis is the hazard rate ($\lambda(t)$). The hazard rate is the conditional probability of failure, i.e., the instantaneous rate of occurrence of the event of interest. In simple survival analysis, in the absence of competing risks, the hazard rate is defined as:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t \mid T \geq t)}{\Delta t} = \frac{f(t)}{S(t)} \tag{1}$$

Here $f(t)$ is the probability density function of the variable T, and $S(t)$ is the survival function ($S(t) = 1 - F(t) = \Pr(T \geq t)$). In this simple case, for the Cox proportional hazards model, we have the following:

$$\lambda(t \mid Z) = \lambda_0(t) \exp(\beta^\top Z) \tag{2}$$

where β is a vector of regression coefficients, Z is a vector of covariates, and $\lambda_0(t)$ represents the baseline hazard.

Before really entering into the discussion of the two approaches to competing risks, it is important to define one of the main quantities of interest here, the cumulative incidence function (CIF). The CIF for the k-th cause is defined as:

$$I_k(t) = \Pr(T \leq t, D = k), \tag{3}$$

[1] I'm particularly indebted to Prof. Alex Flores for gently sending me the paperback edition of his book. Without his act of pure kindness and academic commitment, my process of learning these methods would have been significantly harder.

where D is a variable denoting the type of event. It is basically the probability of failing from a given cause k before time t. The cumulative incidence is a special case of the Aalen-Johansen estimator, which is why it is possible to use this estimator to calculate it. We will return to the discussion about the CIF right back, but now it is important to stress the differences in the types of hazard functions.

In the presence of competing risks, where there are multiple events of interest, there are two possible approaches to the hazard functions: the cause-specific hazard function and the subdistribution hazard function. The cause-specific hazard function is defined as follows:

$$\lambda_k(t) = \lim_{\Delta t \to 0} \frac{\Pr(t \leq T < t + \Delta t, D = k \mid T \geq t)}{\Delta t} \tag{4}$$

where $\lambda_k(t)$ is the cause-specific hazard function for cause k. Here, when an individual experiences a competing event, he leaves the risk set. Therefore, in the cause-specific approach, the hazard function is the instantaneous rate of occurrence of the k-th event in individuals who have not yet experienced any event. In a Cox regression, in this case, individuals who experience an event different from k are treated as censored. Importantly, each cause is assumed to have its own baseline hazard function. In terms of cause-specific hazards, the CIF is expressed as follows:

$$I_k(t) = \int_0^t \lambda_k(s) S(s)\, ds \tag{5}$$

Here, events from causes other than k are treated as censored. Therefore, the naive Kaplan–Meier estimate is given by:

$$1 - S_k(t) = \int_0^t \lambda_k(s) S_k(s)\, ds \tag{6}$$

Comparing this with the immediately anterior equation we see an important difference. $S(s)$ is replaced by $S_k(s)$. Since $S(t) \leq S_k(t)$, we have $I_k(t) \leq 1 - S_k(t)$. Here resides precisely that bias described in the first paragraph of section 5.2 of the paper. The artificial censoring of units that do not fail for the right reason causes that bias, which makes the Kaplan-Meier estimator inappropriate in the presence of competing risks.

However, the cause-specific approach does not allow for the estimation of the covariate effects on the CIFs. This is because the CIF for cause k not only depends on the hazard of k, but also on the hazards of all other causes. In some cases, the direction of the relationship on the cumulative scale can even reverse. The proposed solution for this problem was given by Fine and Gray in their 1999 paper. There they introduce the subdistribution hazard function, which has the following format:

$$\gamma_k(t) = \lim_{\Delta t \to 0} \frac{\text{Prob}(t \leq T \leq t + \Delta t, D = k | T \geq t \cup (T \leq t \cap K \neq k))}{\Delta t} \tag{7}$$

Different from the cause-specific approach, it is possible to see that the risk set includes those who have not experienced an event yet and those who have previously experienced a competing event). The main difficulty here is that the occurrence of $D = k$ precludes the occurrence of any other $D \neq k$. The solution from Fine and Gray involves defining the distribution function for the

improper random variable T^* as follows:

$$T^* = I(D = k)T + I(D \neq k)\infty. \tag{8}$$

As discussed earlier, the hazard rate is the ratio $f(t)/S(t)$ and both can be expressed as functions of the CIF. Therefore:

$$\gamma_k(t) = -\frac{d\log(1 - I_k(t))}{dt} \tag{9}$$

The two models presented here have advantages and disadvantages, and a researcher must be aware of these differences when interpreting the results. The cause-specific approach, which is the multi-state approach for competing risks, is more straightforward in terms of estimation and interpretation. It is fundamental to distinguish the interpretation about the incidence rate and the hazard rate. If one is aware that it does not estimate the covariate effect on the CIFs and explicitly explains that in the discussion, this is perhaps the most immediate choice regarding competing risks for political science.

Multi-state survival models are starting to become more popular in political science (Metzger and Jones, 2016). However, the use of competing risks models in political science is still somewhat rare, especially in the study of international organizations. A brief search in Google Scholar reported very few articles in this area that use these approaches and provide a comprehensive discussion of these methods in international relations.

Most of the literature I used to write this section is medical literature and is concerned with medical problems, which are different from political science problems and research questions. However, their insights about which approach is more appropriate to which question are still relevant here. This literature tends to defend that cause-specific hazards are more appropriate for addressing epidemiological questions of etiology and subdistribution hazards for clinical prediction models. Moreover, when the focus is on understanding the underlying mechanisms of a given process, this medical literature tends to favor cause-specific hazards.

Perhaps for political science, the inferential[2] question is the most important. Here, the standard procedure established by Latouche et al. (2013) can be adapted and used in political science for a more appropriate analysis of competing risks. Some of the most important recommendations are:

- Using a distinct terminology for each model of the hazard ratio, namely cause-specific hazards for the Cox model and subdistribution hazards for the Fine and Gray model;
- Reporting all the cause-specific hazards;
- Reporting the subdistribution hazard for the event of interest and the subdistribution hazard for the competing event;
- Presenting the results in a unified interpretation, so as to connect and reconcile results from the two sets of models;

[2]The discussion about causality, even in the context of competing risks in medical literature, is really complex and exceeds the scope of our discussion here.

- Explicitly checking the proportional hazards assumption for the Cox and Fine and Gray models.

In my article I tried to follow these recommendations, with the small difference that I reported the coefficients rather than the hazard ratios, which appears to be a more straightforward approach for a political science audience. Jones and Metzger (2019), while giving recommendations for duration models in a broader sense, also provide an important framework for political scientists interested in these discussions.

Table A1: Descriptive statistics

Variable	Mean	SD	Median	Min	Max
IO death	0.010	0.101	0	0	1
Duration	27.884	25.249	21	1	200
Institutional overlap	0.023	0.026	0.015	0	0.274
Number of members	29.190	37.619	16	1	193
Number of living IOs	236.502	106.035	286	0	336
Policy scope	1.841	1.062	2	0	8
Governance mandates	3.538	1.572	3	0	8
Institutionalization	3.183	1.497	3	0	6

Table A2: IOs that ended due to contract-based terminations

Acronym	Organization Name	Birth	Death	Type
AMSC	African and Malagasy Sugar Council	1966	1977	Dissolution
ACI	African Cultural Institute	1971	1999	Dissolution
AMCO	African Malagasy Coffee Organization	1960	2007	Dissolution
OCAM	Afro-Malagasy Union	1961	1985	Dissolution
AITIC	Agency for International Trade Information and Cooperation	2004	2011	Dissolution
ASPAC	Asian and Pacific Council	1966	1973	Dissolution
Corg	Caribbean Organization	1960	1965	Dissolution
CAMSF	Central American Monetary Stabilization Fund	1969	1991	Dissolution
CARII	Central American Research Institute for Industry	1956	1997	Dissolution
CPAB	Central Pan American Bureau of Eugenics and Homiculture	1927	1949	Dissolution
CENTO	Central Treaty Organization	1955	1979	Dissolution
CIFC	Commission for International Financial Control in Macedonia	1905	1914	Dissolution
CHSTEA	Conference of Heads of State of Equatorial Africa	1960	1968	Dissolution
CMEA	Council for Mutual Economic Aid	1949	1991	Dissolution
EACM	East African Common Market	1967	1977	Dissolution
EMB	Empire Marketing Board	1926	1933	Dissolution
ECCD	European Commission for Control of the Danube	1856	1939	Dissolution
ECCPIF	European Company for Chemical Processing of Irradiated Fuels	1957	1984	Dissolution
FEC	Far East Commission	1945	1951	Dissolution

Continued

Acronym	Organization Name	Birth	Death	Type
GLACSEC	Group of Latin American and Caribbean Sugar Exporting Countries	1974	2001	Dissolution
G3	Group of Three	1995	2006	Dissolution
GCRSNC	Guidance Committee for Road Safety in Nordic Countries	1993	1999	Dissolution
IARA	Inter-Allied Reparation Agency	1946	1955	Dissolution
IARHC	Inter-Allied Rhineland High Commission	1919	1934	Expiry
IAII	Inter-American Indian Institute	1940	1953	Dissolution
IARadiO	Inter-American Radio Office	1937	1963	Dissolution
IATB	Inter-American Trademark Bureau	1917	1944	Dissolution
IBI	Intergovernmental Bureau for Informatics	1974	1991	Dissolution
IAMLO	International African Migratory Locust Organization	1952	1985	Dissolution
IATSJ	International Arbitration Tribunal at San Jose	1907	1916	Dissolution
IAS	International Association of Seismology	1903	1922	Dissolution
IARuhr	International Authority for the Ruhr	1949	1953	Dissolution
IBCS	International Bureau of Commercial Statistics	1913	1935	Dissolution
ICCSLT	International Commission of the Cape Spartel Light in Tangier	1865	1958	Dissolution
ICTM	International Commission on the Teaching of Mathematics	1908	1939	Dissolution
IJO	International Jute Organization	1984	2001	Expiry
IMBSlav	International Maritime Bureau Against the Slave Trade	1890	1909	Dissolution
INRO	International Natural Rubber Organization	1980	1999	Expiry

Continued

Acronym	Organization Name	Birth	Death	Type
IRO	International Refugee Organization	1946	1952	Dissolution
IRU	International Relief Union	1927	1968	Dissolution
ITC	International Tin Council	1956	1990	Dissolution
IWSG	International Wool Study Group	1947	1992	Dissolution
LoN	League of Nations	1919	1945	Dissolution
NERC	Nordic Economic Research Council	1979	1996	Dissolution
NTSC	Nordic Telecommunications Satellite Council	1965	1986	Dissolution
NPFSC	North Pacific Fur Seal Commission	1958	1988	Dissolution
SEATO	Southeast Asia Treaty Organization	1954	1977	Dissolution
SAAFA	Special Arab Aid Fund for Africa	1974	1977	Dissolution
SCH	Superior Council of Health	1838	1914	Dissolution
TCRMG	Tripartite Commission for the Restitution of Monetary Gold	1946	1998	Dissolution
UKDWD	United Kingdom–Dominion Wool Disposals	1945	1953	Dissolution
WPact	Warsaw Treaty Organization	1955	1991	Dissolution
WEU	Western European Union	1955	2011	Dissolution

Table A3: IOs that ended due to transformation-based terminations

Acronym	Organization Name	Birth	Death	Type
APTU	African Postal and Telecommunications Union	1935	1965	Succession
AMIPO	Afro-Malagasy Industrial Property Office	1962	1975	Succession
AMPTU	Afro-Malagasy Postal and Telecommunications Union	1961	1996	Succession
ACCT	Agence de La Francophonie	1970	2005	Succession
AOMR	Arab Organization for Mineral Resources	1979	1991	Merger
AIDC	Asian Industrial Development Council	1966	1974	Merger
ABEPSEAC	Association between the European Economic Community and Partner States	1968	1975	Succession
BIISEF	Banque internationale d'information sur les Etats francophones	1986	1996	Absorption
CComm	Caribbean Commission	1946	1959	Succession
CARIFTA	Caribbean Free Trade Association	1966	1973	Succession
UDEAC	Central African Customs and Economic Union	1964	1994	Succession
CACB	Central American Coffee Board	1975	1979	Succession
CAECC	Central Asian Economic Community	1994	2006	Absorption
CBI	Central Bureau for the International Map of the World	1909	1953	Merger
CTCAf	Commission for Technical Cooperation in Africa South of the Sahara	1950	1965	Succession
CAARC	Commonwealth Advisory Aeronautical Research Council	1946	1993	Absorption

Continued

Acronym	Organization Name	Birth	Death	Type
ComAB	Commonwealth Agricultural Bureau	1929	1985	Succession
CEC	Commonwealth Economic Committee	1925	1967	Absorption
CELC	Commonwealth Education Liaison Committee	1960	1967	Absorption
CAMRSD	Conference of African Ministers Responsible for Sustainable Development	1993	1997	Succession
CMAEC	Council of Ministers for Asian Economic Cooperation	1968	1971	Succession
EACSO	East African Common Services Organization	1961	1967	Succession
ECCM	East Caribbean Common Market	1968	1981	Absorption
ECCA	Eastern Caribbean Currency Area	1979	1983	Succession
ECSC	European Coal and Steel Community	1952	1992	Absorption
EUROMET	European Collaboration on Measurement Standards	1987	2007	Succession
EFCC	European Food Code Council	1958	1965	Absorption
EEC	European Economic Community	1958	1992	Absorption
EMI	European Monetary Institute	1994	1998	Succession
EPU	European Payments Union	1950	1958	Succession
EPA	European Productivity Agency	1953	1961	Absorption
ESRO	European Space Research Organization	1964	1975	Merger
ELDO	European Space Vehicle Launcher Development Organization	1964	1975	Merger
GATT	General Agreement on Tariffs and Trade	1948	1995	Succession
SCHENGEN	Group of Schengen	1985	1999	Absorption
IDC	Imperial Defense Committee	1920	1946	Absorption
IIE	Imperial Institute of Entomology	1920	1933	Succession

Continued

Acronym	Organization Name	Birth	Death	Type
IMI	Imperial Mycological Institute	1920	1933	Succession
IACS	Inter-African Committee on Statistics	1954	1965	Succession
IAPhy	Inter-African Phytosanitary Convention	1954	1960	Absorption
IACB	Inter-American Coffee Board	1940	1948	Succession
IACW	Inter-American Commission of Women	1928	1965	Absorption
IGCC	Intergovernmental Copyright Committee	1952	1971	Absorption
ICCILMB	Interim Committee for Coordination of Investigations of the Lower Mekong Basin	1978	1995	Succession
IBIER	International Bureau for Information and Enquiries regarding Relief	1907	1921	Absorption
IBE	International Bureau of Education	1929	1969	Absorption
ICNWAF	International Commission for the Northwest Atlantic Fisheries	1949	1978	Succession
IIA	International Institute of Agriculture	1905	1945	Succession
IMC	International Moselle Company	1956	1987	Succession
INPFC	International North Pacific Fisheries Commission	1952	1992	Succession
IOPH	International Office of Public Hygiene	1907	1946	Succession
IPI	International Patent Institute	1947	1977	Absorption
IPentC	International Penitentiary Commission	1875	1951	Absorption
IRLCS	International Red Locust Control Service	1949	1970	Succession
ISuC	International Sugar Council	1937	1967	Succession
ITCLE	International Technical Committee of Legal Experts on Air Questions	1926	1941	Succession

Continued

Acronym	Organization Name	Birth	Death	Type
INTELSAT	International Telecommunications Satellite Organization	1964	2001	Succession
ITCC	International Telegraph Consultative Committee	1925	1956	Merger
IVWO	International Wine Office	1924	2003	Succession
IOATHRE	Inter-State Organization for Advanced Technicians of Hydraulics	1972	2004	Merger
LAFTA	Latin American Free Trade Association	1961	1980	Succession
NCRR	Nordic Council for Reindeer Research	1980	1992	Absorption
OAU	Organization for African Unity	1963	2002	Succession
OEEC	Organization for European Economic Cooperation	1948	1961	Succession
OMDKR	Organization for the Management and Development of the Kagera River	1977	2000	Absorption
OCAS	Organization of Central American States	1951	1991	Succession
OSLO	Oslo Commission	1972	1998	Succession
PC	Paris Commission	1977	1998	Succession
PAHC	Permanent Association of Pan American Highway Congresses	1939	1952	Absorption
PIBAC	Permanent International Bureau of Analytical Chemistry	1923	1934	Succession
PTASEA	Preferential Trade Agreement for Southern & Eastern Africa	1981	1994	Succession
RadioU	Radiotelegraph Union	1906	1926	Merger
SCAf	Scientific Council for Africa South of the Sahara	1950	1965	Merger
SARTC	Southern Africa Regional Tourism Council	1973	1996	Succession
SADCC	Southern African Development Coordination Conference	1980	1992	Succession

Continued

Acronym	Organization Name	Birth	Death	Type
UIUCV	Union for the International Use of Carriages and Vans	1923	1979	Succession
UMAC	Union montaire de l'Afrique centrale	1972	1994	Absorption
CEAO	West African Economic Community	1960	1994	Succession
WAHC	West African Health Community	1972	1987	Succession
UMOA	West African Monetary Union	1962	1994	Succession

Table A4: IOs that ended due to inertia-based terminations

Acronym	Organization Name	Birth	Death	Type
ASCBC	African Standing Conference on Bibliographic Control	1978	2000	Desuetude
ACDT	American Committee on Dependent Territories	1948	1956	Desuetude
ACML	Arab Centre for Medical Literature	1983	2000	Desuetude
ACC	Arab Cooperation Council	1989	1990	Desuetude
AIOEC	Association of Iron Ore Exporting Countries	1975	1998	Desuetude
ATPC	Association of Tin Producing Countries	1983	2001	Desuetude
BNDP	Board of Nordic Development Projects	1968	1987	Desuetude
CAEC	Central American Energy Commission	1979	1993	Desuetude
CEEPN	Central and Eastern European Privatization Network	1991	2001	Desuetude
CCOM	Central Compensation Office of the Maghreb	1969	2000	Desuetude
CATC	Commonwealth Air Transport Council	1945	1991	Desuetude
DBGLS	Development Bank of the Great Lakes States	1977	2000	Desuetude
EPFSC	European Postal Financial Services Commission	1992	2006	Desuetude
GBACT	Group on the Balkan Agreement on Cooperation on Tourism	1971	1988	Desuetude
IAHC	Inter-American High Commission	1916	1931	Desuetude
ICCEC	Intergovernmental Council of Copper Exporting Countries	1968	1997	Desuetude
IABath	International Association for Public Baths and Cleanliness	1912	1923	Desuetude
IBA	International Bauxite Association	1974	1997	Desuetude

Continued

Acronym	Organization Name	Birth	Death	Type
ICAmO	International Central American Office	1907	1914	Desuetude
IChemO	International Chemistry Office	1927	1950	Desuetude
ICDR	International Commission for the Decennial Revision of the Nomenclature	1900	1938	Desuetude
ICNC	International Commission for the Navigation of the Congo	1885	1914	Desuetude
IComO	International Commission for the Oder	1919	1936	Desuetude
ICSEAF	International Commission for the Southeast Atlantic Fisheries	1969	1990	Desuetude
ICPTU	International Conference for Promoting Technical Unification on the Railways	1882	1938	Desuetude
IEC	International Elbe Commission	1919	1936	Desuetude
IES	International Exchange Service	1886	1939	Desuetude
IFCA	International Finance Commission at Athens	1898	1914	Desuetude
IICom	International Institute of Commerce	1919	1943	Desuetude
IPrizeC	International Prize Court	1907	1914	Desuetude
ISUPT	International Secretariat for the Unification of Pharmacological Terms	1902	1914	Desuetude
ITPA	International Tea Promotion Association	1977	1984	Desuetude
IUPR	International Union of Pruth (River)	1878	1914	Desuetude
ISHREST	Inter-State School of Hydraulic and Rural Engineering for Senior	1972	1996	Desuetude
JALAAO	Joint Anti-Locust and Anti-Aviarian Organization	1965	2001	Desuetude

Continued

Acronym	Organization Name	Birth	Death	Type
JNOLCRH	Joint Nordic Organization for Lappish Culture and Reindeer Husbandry	1965	2000	Desuetude
PICS	Permanent International Commission of Studies on Sanitary Equipment	1925	1938	Desuetude
PSNARCO	Permanent Secretariat of the South American Agreement on Narcotic Drugs and Psychotropic Substances	1979	1998	Desuetude
RepCom	Reparation Commission	1919	1933	Desuetude
SWAPU	South and West Asia Postal Union	1987	2006	Desuetude
SCA	Suez Canal Administration	1888	1914	Desuetude
UBEC	Union of Banana Exporting Countries	1974	1996	Desuetude

Figure A1: Schoenfeld residuals for independent variables

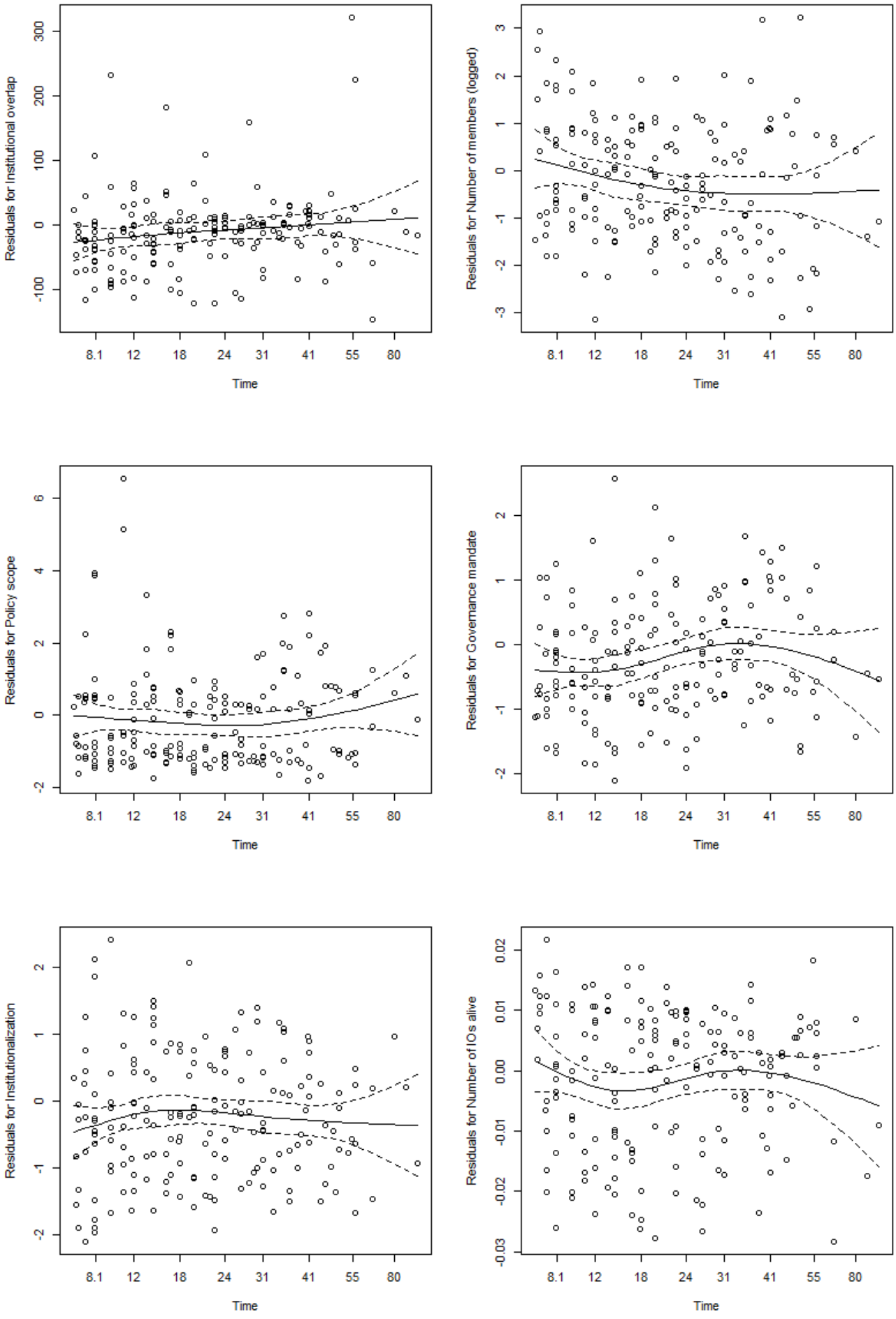


Table A5: Results from Table 1 using the Breslow method for ties

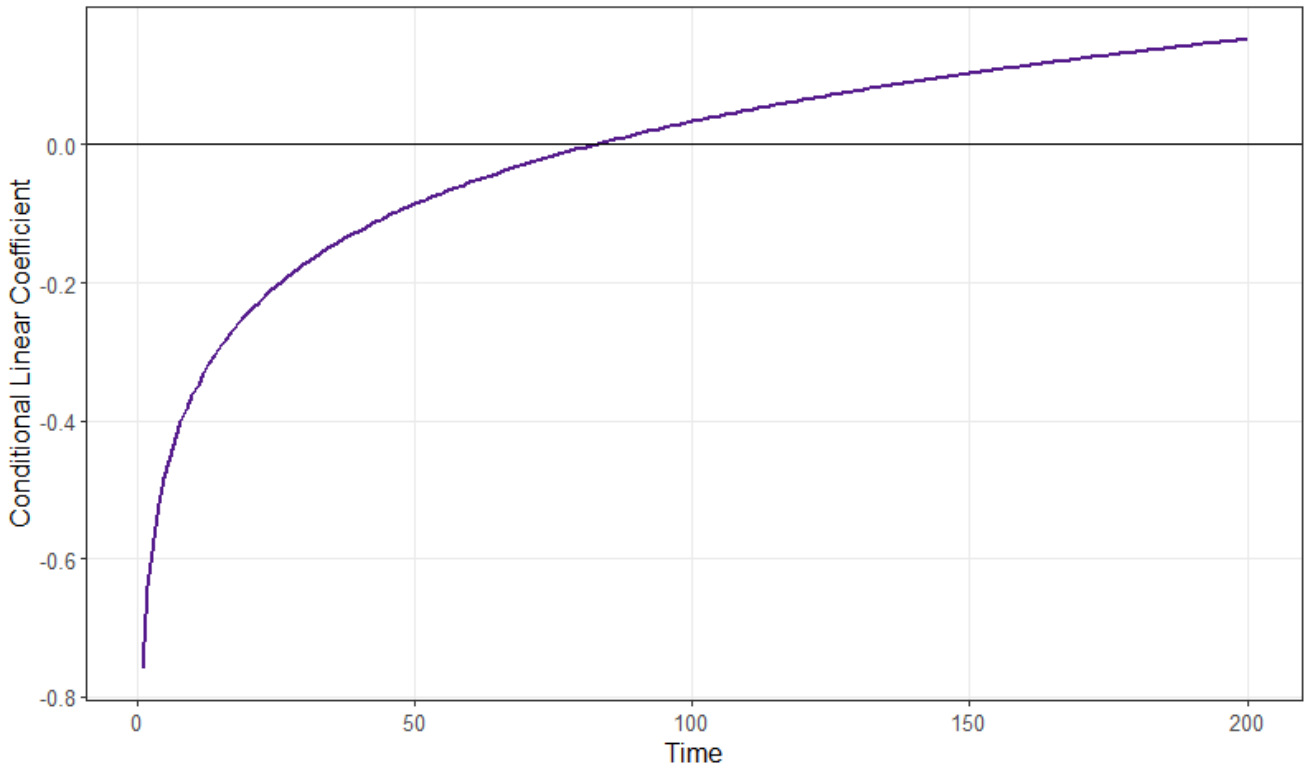
	Dependent variable:
	IO death
Institutional overlap	-10.374^{***}
	(4.709)
Number of members (logged)	-0.275^{***}
	(0.101)
Policy scope	-0.131
	(0.094)
Governance mandate	-0.751^{***}
	(0.267)
Governance mandate * ln(t)	0.170^{**}
	(0.085)
Institutionalization	-0.233^{***}
	(0.063)
Number of IOs alive	-0.001^{*}
	(0.001)
Number of failures	181
Observations	18,213
Log Likelihood	-978.683
Wald Test	107.320^{***} (df = 7)
LR Test	109.308^{***} (df = 7)
Score (Logrank) Test	99.168^{***} (df = 7)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table A6: Results from Table 2 using the Breslow method for ties

	Dependent variable					
	Contract		Transformation		Inertia	
	CSH	FG	CSH	FG	CSH	FG
Institutional overlap	−26.516***	−23.220**	−10.542*	−7.333	−2.733	1.506
	(11.266)	(11.157)	(7.319)	(7.212)	(8.341)	(8.124)
Number of members (logged)	−0.210	−0.136	−0.138	−0.105	−0.492**	−0.444**
	(0.197)	(0.196)	(0.149)	(0.149)	(0.242)	(0.243)
Policy scope	−0.250	−0.266	−1.540**	−0.547**	−0.177	−0.137
	(0.211)	(0.210)	(0.696)	(0.268)	(0.228)	(0.223)
Policy scope * ln(t)			0.452**	0.015**		
			(0.215)	(0.008)		
Governance mandate	−0.288**	−0.242*	−0.142	−0.249	−0.310**	−0.263**
	(0.141)	(0.138)	(0.096)	(0.161)	(0.162)	(0.159)
Governance mandate * ln(t)				0.005		
				(0.005)		
Institutionalization	−0.264*	−0.233*	−0.166	−0.124	−0.348**	−0.308**
	(0.130)	(0.124)	(0.096)	(0.093)	(0.146)	(0.139)
Number of IOs alive	−0.003**	−0.003*	−0.001	0.00001	−0.003	−0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Number of failures	46	46	77	77	36	36
Observations	17,865	19,763	17,865	19,351	17,865	19,479
Log Likelihood	−233.115	−244.751	−423.428	−433.861	−186.005	−195.368
Wald Test	54.040***	40.500***	30.710***	26.030***	63.650***	47.760***

Note: *p<0.1; **p<0.05; ***p<0.01
CSH: Cause-Specific hazards model; FG: Fine-Gray subdistribution hazards model

Figure A2: Conditional linear coefficient for Governance mandate



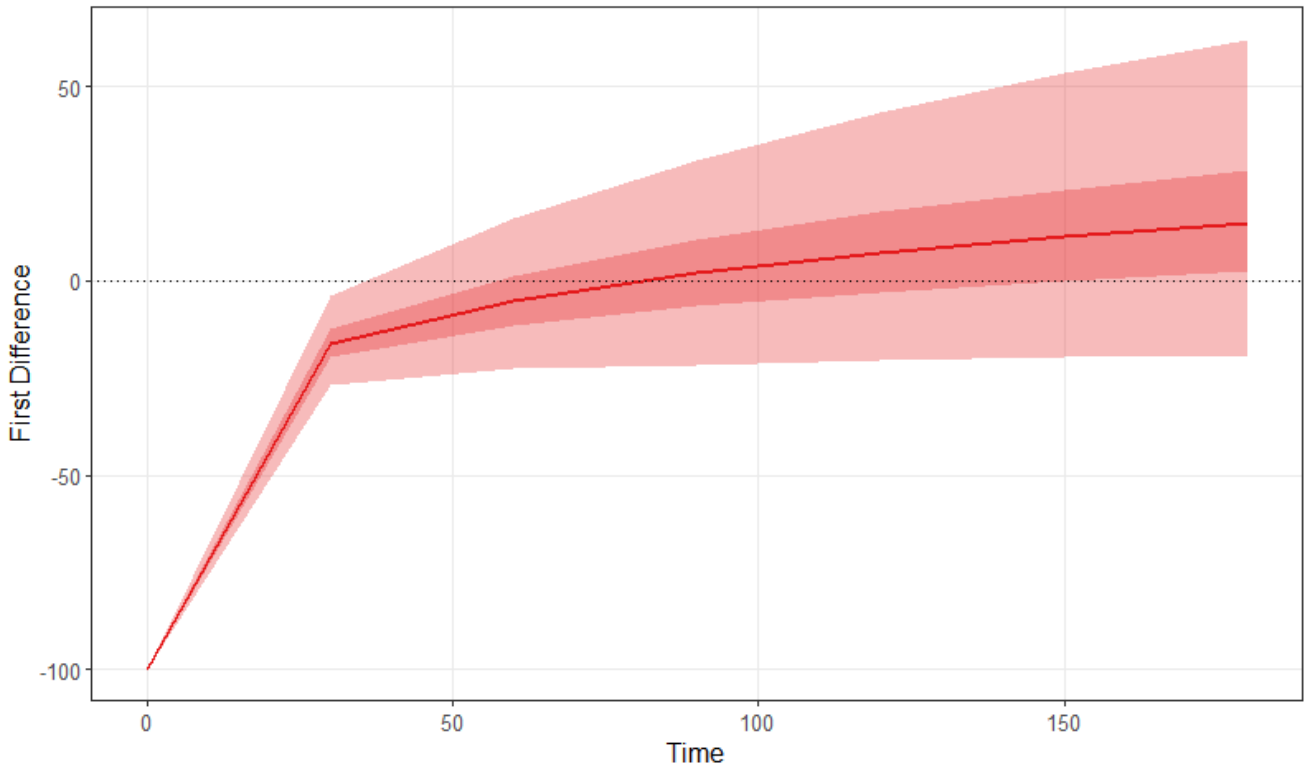
As Flores (2022) notes, after correcting the model with the time interaction, multiple quantities of interest can be reported. One possibility is looking at the term $Z\beta_1 + \ln(t)Z\beta_2$ in $\lambda_0(t)\exp\left(Z\beta_1 + \ln(t)Z\beta_2\right)$. Here, changes in Z reflect changes in the hazard rates. If Z is continuous, the marginal effect of Z on $Z\beta_1 + \ln(t)Z\beta_2$ is:

$$\frac{\partial(Z\beta_1 + \ln(t)Z\beta_2)}{\partial Z} = \beta_1 + \beta_2 \ln(t)$$

This quantity is the conditional linear coefficient. In the case of the governance mandate dimension of my model, the conditional linear coefficient is $-0.761 + 0.172ln(t)$, where t represents time. Starting from -0.761 at t = 0, the effect gradually weakens (becomes less negative) over time. Around 84 years ($e^{\frac{0.761}{0.172}}$), the effect is indistinguishable from zero. Therefore, the protective effect of governance mandate in IO survival is relevant in the early stages of an IO, but tends to decrease monotonically and logarithmically over time.

However, as mentioned, this quantity makes more sense when the variable is continuous. The way I measured governance mandates is discrete. In this case, we should focus on simulated first differences instead.

Figure A3: Simulated first differences for Governance mandate



In the case of discrete variables, two quantities of interest are the relative hazards and the first differences, which are the percent changes in the hazard rates (Flores, 2022). A relative hazard is a type of hazard ratio, and in the context of nonproportionality, it is the following:

$$\frac{\lambda_i(t)}{\lambda_{\neg i}(t)} = \frac{\lambda_0(t)\exp(Z_i\beta_1 + \ln(t)Z_i\beta_2)}{\lambda_0(t)\exp(Z_{\neg i}\beta_1 + \ln(t)Z_{\neg i}\beta_2)} = \exp((Z_i - Z_{\neg i})(\beta_1 + \ln(t)\beta_2))$$

In this case, the percentual change in the hazard rate for unit i relative to unit $\neg i$ is calculated as follows:

$$\%\Delta\lambda_i(t) = (\exp((Z_i - Z_{\neg i})(\beta_1 + \ln(t)\beta_2)) - 1) \times 100$$

Figure A3 shows precisely that, i.e., the percent change in the hazard rate as given by a change in my variable Governance mandate. These results confirm what was shown in the previous figure. Here, governance tasks have a time-dependent effect, which has a protective effect on the early stages of an IO's life cycle, but when time passes, it converges toward zero.

Table A7: Cox regression with a shared frailty on function

	Dependent variable: IO death
Fixed Effects	
Institutional overlap	-9.744^{**}
	(4.720)
Number of members (logged)	-0.264^{***}
	(0.100)
Policy scope	-0.144
	(0.095)
Governance mandate	-0.775^{***}
	(0.267)
Governance mandate * ln(t)	0.175^{**}
	(0.085)
Institutionalization	-0.238^{***}
	(0.063)
Number of IOs alive	-0.002^{*}
	(0.001)
Random Effects	
Variance	0.042
Standard Deviation	0.205
Observations	18,213
Number of failures	181
Integrated Log Likelihood	113.0
Penalized Log Likelihood	118.7
Note:	*p<0.1; **p<0.05; ***p<0.01

Table A8: Cox regression with a shared frailty on scope

	Dependent variable: IO death
Fixed Effects	
Institutional overlap	-10.54^{**}
	(4.711)
Number of members (logged)	-0.277^{**}
	(0.100)
Policy scope	-0.131
	(0.094)
Governance mandate	-0.761^{***}
	(0.267)
Governance mandate * ln(t)	0.172^{**}
	(0.085)
Institutionalization	-0.236^{***}
	(0.063)
Number of IOs alive	-0.001^{*}
	(0.001)
Random Effects	
Variance	0.0003992
Standard Deviation	0.01998
Observations	18,213
Number of failures	181
Integrated Log Likelihood	95.16
Penalized Log Likelihood	97.16
Note:	*p<0.1; **p<0.05; ***p<0.01

Table A9: Cox regression with a shared frailty on region

	Dependent variable: IO death
Fixed Effects	
Institutional overlap	-9.998^{**}
	(4.752)
Number of members (logged)	-0.220^{**}
	(0.106)
Policy scope	-0.127
	(0.094)
Governance mandate	-0.778^{***}
	(0.268)
Governance mandate * ln(t)	0.176^{**}
	(0.085)
Institutionalization	-0.240^{***}
	(0.063)
Number of IOs alive	-0.002^{*}
	(0.001)
Random Effects	
Variance	0.0314
Standard Deviation	0.177
Observations	18,213
Number of failures	181
Integrated Log Likelihood	111.7
Penalized Log Likelihood	117.5
Note:	*p<0.1; **p<0.05; ***p<0.01

Table A10: Cox regression with a shared frailty on membership format

	Dependent variable: IO death
Fixed Effects	
Institutional overlap	-10.977^{*}
	(4.800)
Number of members (logged)	-0.229^{**}
	(0.105)
Policy scope	-0.117
	(0.093)
Governance mandate	-0.259^{***}
	(0.068)
Institutionalization	-0.252^{***}
	(0.065)
Number of IOs alive	-0.001^{*}
	(0.001)
Random Effects	
Variance	0.000079
Standard Deviation	0.009
Observations	17,822
Number of failures	178
Integrated Log Likelihood	106.2
Penalized Log Likelihood	106.2
Note:	*p<0.1; **p<0.05; ***p<0.01

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