Blood is Thicker than Water: Family Size and Leader Deposition in Medieval and Early Modern Europe - Online Appendix

Contents

1 Descriptives **1**

1.1 States in the sample 1

1.2 Proportion married 2

2 Alternative specifications **3**

2.1 Regression with civil war as dependent variable 4

2.2 Logit regression 5

2.3 Cox regression 6

2.4 Regression with country-century fixed effects. 7

2.5 Regression with squared term of family size. 8

2.6 Regression without control variables. 9

2.7 Full table of multinomial logit analysis 10

3 Accounting for endogeneity **11**

3.1 Fertility 11

3.2 Natural deaths as outcome 13

3.3 Split sample on eventual age at death 15

3.4 Family deaths in advance of depositions 16

3.5 Regression with controls for deaths in the family and war 18

3.6 Regression with lagged family variables 21

3.7 Regression with different proxies 22

4 An illustration of the mechanism **24**

1 Descriptives

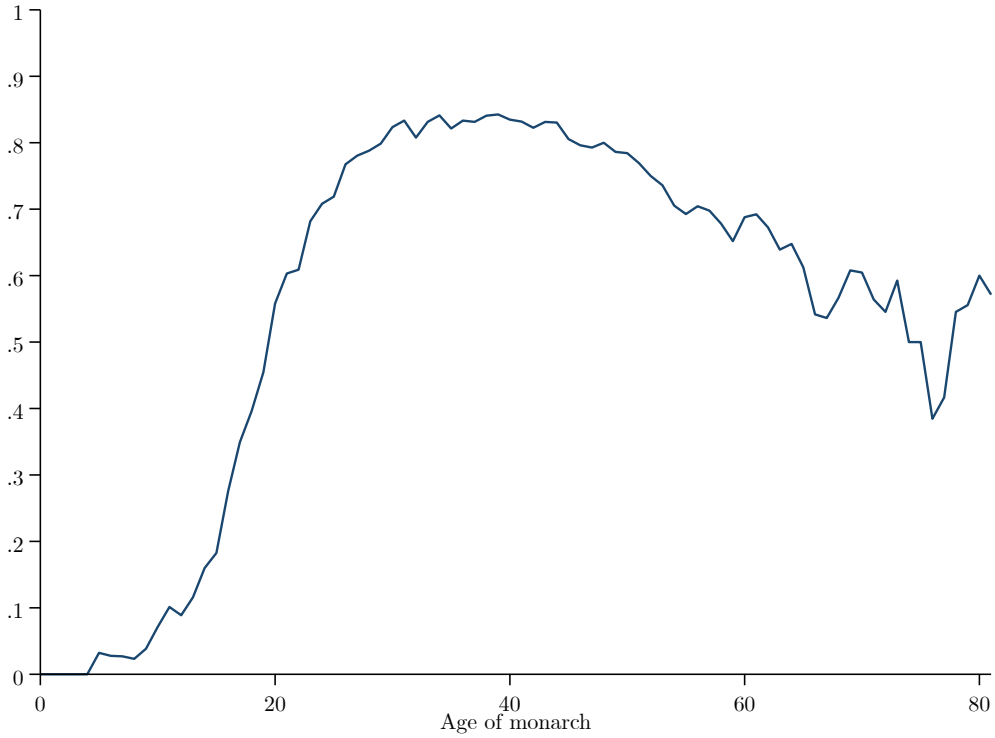
1.1 States in the sample

Table A1: States included in the sample.

State	First year in sample	Last year in sample
Aragon	1035	1479
Austria	1359	1792
Bavaria	1651	1799
Brandenburg/Prussia	1356	1786
Byzantine Empire	1025	1453
Bohemia	1230	1740
Castile	1035	1516
Denmark	1014	1799
England/Great Britain	1066	1799
France	1031	1793
Hungary	1001	1740
Holy Roman Empire	1002	1378
Leon	1028	1230
Lithuania	1382	1569
Naples	1072	1504
Navarre	1004	1610
Norway	1000	1559
Palatinate	1356	1799
Poland	1025	1795
Portugal	1095	1788
Russia	1359	1799
Savoy	1383	1799
Saxony	1356	1799
Scotland	1034	1707
Sicily	1282	1409
Spain	1516	1788
Sweden	1130	1792

1.2 Proportion married

Figure A1: Proportion monarchs that were married, over monarch age.



2 Alternative specifications

In this section, we present the full tables of analyses only reported graphically in the paper (Table A2 and Table A8), as well as three alternative estimation strategies. In Table A3, we use logistical regression instead of linear probability models. The patterns are the same, even if some observations are dropped (countries with no depositions): Family size in general is significantly associated with a lower rate of deposition, and the effect is primarily driven by the effects of children and siblings.

The same holds true when we in Table A4 use survival models, where the unit of analysis is the monarch. The time variable is tenure of the reign, and failure is deposition. Finally, we see the same patterns in Table A5, where we again use LPM, but with controls for country-century fixed effects.

2.1 Regression with civil war as dependent variable

Table A2: Regression: Civil war onset as dependent variable. Coefficients multiplied by 100.

	(1)	(2)	(3)
Family size	-0.151**		
	(-2.93)		
Children		-0.161*	
		(-2.40)	
Siblings		-0.190	
		(-1.93)	
Uncles and aunts		0.008	
		(0.06)	
Sons			-0.178
			(-1.44)
Daughters			-0.178
			(-1.40)
Brothers			-0.424*
			(-2.27)
Sisters			-0.015
			(-0.09)
Uncles			0.166
			(0.53)
Aunts			-0.059
			(-0.25)
Female	-0.481	-0.491	-0.514
	(-0.57)	(-0.57)	(-0.60)
Married	0.387	0.395	0.380
	(1.02)	(1.04)	(1.00)
Primogeniture	-0.359	-0.342	-0.386
	(-0.57)	(-0.55)	(-0.62)
Illegitimate	1.531	1.504	1.474
	(1.67)	(1.64)	(1.61)
Parliamentary meeting	0.052	0.007	-0.028
	(0.10)	(0.01)	(-0.05)
Constant	3.087	2.868	2.856
	(1.49)	(1.38)	(1.37)
N	13641	13641	13641
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes
R2(adj):	0.030	0.030	0.030

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.2 Logit regression

Table A3: Logit regression: Family size and deposition

	(1)	(2)	(3)
Family size	-0.122**		
	(-3.14)		
Children		-0.114*	
		(-2.51)	
Siblings		-0.151*	
		(-2.38)	
Uncles and aunts		-0.051	
		(-0.50)	
Sons			-0.053
			(-0.70)
Daughters			-0.185*
			(-2.05)
Brothers			-0.115
			(-1.29)
Sisters			-0.182*
			(-2.00)
Uncles			0.057
			(0.36)
Aunts			-0.169
			(-0.81)
Female	-0.702	-0.703	-0.673
	(-1.36)	(-1.36)	(-1.29)
Married	-0.033	-0.040	-0.041
	(-0.18)	(-0.22)	(-0.22)
Primogeniture	-1.087***	-1.096***	-1.055***
	(-3.53)	(-3.54)	(-3.43)
Illegitimate	0.231	0.207	0.200
	(0.70)	(0.62)	(0.59)
Parliamentary meeting	-0.008	-0.019	0.027
	(-0.03)	(-0.07)	(0.10)
Constant	-2.769**	-2.820***	-2.820***
	(-3.26)	(-3.33)	(-3.31)
N	11973	11973	11973
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes
Pseudo R2	0.104	0.105	0.105

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.3 Cox regression

Table A4: Cox regression: Family size and deposition

	(1)	(2)	(3)
Family size	-0.111***		
	(-3.49)		
Children		-0.098*	
		(-2.34)	
Siblings		-0.146**	
		(-2.70)	
Uncles and aunts		-0.051	
		(-0.48)	
Sons			-0.040
			(-0.54)
Daughters			-0.165
			(-1.88)
Brothers			-0.102
			(-1.16)
Sisters			-0.184*
			(-2.09)
Uncles			0.060
			(0.34)
Aunts			-0.173
			(-0.90)
Female	-0.619	-0.621	-0.590
	(-1.39)	(-1.39)	(-1.32)
Married	0.023	0.010	0.009
	(0.13)	(0.06)	(0.05)
Primogeniture	-1.064***	-1.074***	-1.030***
	(-3.48)	(-3.50)	(-3.32)
Illegitimate	0.264	0.230	0.227
	(0.77)	(0.67)	(0.66)
Parliamentary meeting	0.002	-0.006	0.044
	(0.01)	(-0.02)	(0.16)
N	13641	13641	13641
Age controls:	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.4 Regression with country-century fixed effects.

Table A5: Regression: Control for country-century fixed effects. Coefficients multiplied by 100.

	(1)	(2)	(3)
Family size	-0.140**		
	(-3.28)		
Children		-0.126**	
		(-2.78)	
Siblings		-0.177**	
		(-2.60)	
Uncles and aunts			
Sons			-0.150
			(-1.65)
Daughters			-0.108
			(-1.43)
Brothers			-0.154
			(-1.33)
Sisters			-0.193*
			(-2.04)
Uncles			-0.136
			(-0.68)
Aunts			-0.042
			(-0.32)
Female	-0.591	-0.603	-0.632
	(-0.90)	(-0.91)	(-0.96)
Married	-0.168	-0.178	-0.179
	(-0.57)	(-0.60)	(-0.60)
Primogeniture	-3.005**	-3.001**	-3.017**
	(-2.72)	(-2.72)	(-2.72)
Illegitimate	0.895	0.846	0.868
	(1.05)	(0.99)	(1.01)
Parliamentary meeting	1.498	1.558	1.586
	(1.25)	(1.32)	(1.32)
Constant	2.741	2.580	2.710
	(1.54)	(1.44)	(1.50)
N	13641	13641	13641
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Country-century fixed effects:	Yes	Yes	Yes
R2(adj):	0.023	0.023	0.023

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.5 Regression with squared term of family size.

Table A6: Regression: Squared family size term. Coefficients multiplied by 100.

	(1)
Family size	-0.303***
	(-3.46)
Family size × Family size	0.013*
	(2.41)
Female	-0.929
	(-1.63)
Married	-0.046
	(-0.17)
Primogeniture	-1.727***
	(-4.10)
Illegitimate	0.672
	(0.81)
Parliamentary meeting	0.010
	(0.03)
Constant	2.702*
	(2.12)
N	13641
Age controls:	Yes
Tenure controls:	Yes
Century fixed effects:	Yes
Country fixed effects:	Yes
R2(adj):	0.016

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.6 Regression without control variables.

Table A7: Regression: Only control for century and country fixed effects (models 1-3) and without any controls (models 4-6). Coefficients multiplied by 100.

	(1)	(2)	(3)	(4)	(5)	(6)
Family size	-0.113***			-0.190***		
	(-3.66)			(-6.79)		
Children		-0.108**			-0.175***	
		(-3.26)			(-5.88)	
Siblings		-0.144**			-0.217***	
		(-2.72)			(-4.37)	
Uncles and aunts		-0.045			-0.182**	
		(-0.69)			(-3.01)	
Sons			-0.084			-0.081
			(-1.18)			(-1.27)
Daughters			-0.125			-0.250***
			(-1.90)			(-4.38)
Brothers			-0.063			-0.089
			(-0.65)			(-0.98)
Sisters			-0.201**			-0.303***
			(-2.86)			(-4.52)
Uncles			0.120			-0.030
			(0.72)			(-0.20)
Aunts			-0.171			-0.299**
			(-1.47)			(-2.66)
Constant	1.385*	1.383*	1.276*	2.223***	2.233***	2.204***
	(2.57)	(2.57)	(2.37)	(10.67)	(10.56)	(10.47)
N	13641	13641	13641	13641	13641	13641
Age controls:	No	No	No	No	No	No
Tenure controls:	No	No	No	No	No	No
Century fixed effects:	Yes	Yes	Yes	No	No	No
Country fixed effects:	Yes	Yes	Yes	No	No	No
R2(adj):	0.010	0.010	0.010	0.003	0.003	0.003

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

2.7 Full table of multinomial logit analysis

Table A8: Dependent variable: Deposition either by family, or others. Reference category: no deposition.

	(1)		(2)		(3)		(4)	
	Family	Other	Family	Other	Family	Other	Family	Other
Family size	-0.051	-0.172***						
	(-0.98)	(-3.83)						
Children			-0.096	-0.132*				
			(-1.39)	(-2.52)				
Siblings			-0.083	-0.207**				
			(-0.73)	(-2.80)				
Uncles and aunts			0.218*	-0.302				
			(2.02)	(-1.95)				
Men					0.137	-0.186**		
					(1.82)	(-2.65)		
Women					-0.272*	-0.159*		
					(-2.21)	(-2.32)		
Sons							0.045	-0.108
							(0.37)	(-1.15)
Daughters							-0.250	-0.169
							(-1.39)	(-1.75)
Brothers							0.182	-0.293*
							(1.48)	(-2.43)
Sisters							-0.400	-0.130
							(-1.72)	(-1.38)
Uncles							0.362	-0.194
							(1.60)	(-0.72)
Aunts							0.076	-0.428
							(0.26)	(-1.56)
Female	-0.107	-0.567	-0.078	-0.597	-0.002	-0.570	0.038	-0.607
	(-0.13)	(-0.97)	(-0.10)	(-1.03)	(-0.00)	(-0.98)	(0.05)	(-1.04)
Married	-0.477	0.213	-0.455	0.183	-0.475	0.212	-0.447	0.181
	(-1.55)	(0.90)	(-1.49)	(0.76)	(-1.54)	(0.89)	(-1.47)	(0.76)
Primogeniture	-0.954**	-1.241***	-0.957**	-1.233***	-0.929**	-1.245***	-0.921**	-1.240***
	(-3.05)	(-4.99)	(-3.02)	(-4.94)	(-2.90)	(-4.98)	(-2.85)	(-4.96)
Illegitimate	0.779*	-0.336	0.777	-0.381	0.762*	-0.336	0.785*	-0.385
	(2.04)	(-0.71)	(1.96)	(-0.80)	(1.99)	(-0.71)	(1.96)	(-0.81)
Parliamentary meeting	-0.368	-0.197	-0.467	-0.166	-0.181	-0.207	-0.303	-0.165
	(-0.94)	(-0.75)	(-1.20)	(-0.62)	(-0.46)	(-0.79)	(-0.78)	(-0.62)
Constant	-4.331**	-3.485***	-4.546**	-3.379***	-4.308**	-3.488***	-4.571**	-3.396***
	(-2.79)	(-3.50)	(-3.04)	(-3.33)	(-2.72)	(-3.51)	(-2.91)	(-3.38)
N	13641		13641		13641		13641	
Age controls:	Yes		Yes		Yes		Yes	
Tenure controls:	Yes		Yes		Yes		Yes	
Century fixed effects:	Yes		Yes		Yes		Yes	
Country fixed effects:	No		No		No		No	
Pseudo R2:	0.106		0.108		0.109		0.112	

z statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3 Accounting for endogeneity

3.1 Fertility

A possible source of endogeneity is that monarchs have fewer children during times of political turbulence, either because it is more dangerous or because they are away from their spouses. If that is the case, smaller family sizes could be associated with higher risks of deposition.

Several of the alternatie specifications in the Appendix deal with this issue, but a simple check is to see whether monarchs actually had fewer children during times of civil war. There are other forms of instability that may not lead to a revolt or civil war, and those are harder to measure, but if monarchs do not have fewer children even during an ongoing revolt or civil war, the threat to endogeneity should not be as grave.

Descriptive statistics suggest that this is not the case: Monarchs on average had 0.12 children per year during peace, and 0.12 children per year in times of civil war. If we restrict the sample to monarchs that were at least 25 and less than 40 years old, the corresponding numbers are 0.19 and 0.20 (the difference is not statistically significant). Table A9 presents the result of analyses where the number of children born each year is the dependent variable.

Civil war is not significantly associated with childbirth, and the coefficient is close to zero. The most important predictors are the dummy variable for being married currently, and the polynomials of age, which is to be expected.

A more surprising result is that more children were born in country-centuries in which at least one parliament convened; this could possibly be due to reverse causality, as a parliament could be convened to approve of an heir (Kokkonen and Møller 2020).

Table A9: Regression: Birth of children

	(1)	(2)	(3)
Ongoing civil war		0.003	
		(0.24)	
Female	-0.013	-0.013	-0.004
	(-0.60)	(-0.59)	(-0.15)
Married	0.159***	0.159***	0.093***
	(17.77)	(17.74)	(6.81)
Primogeniture	0.007	0.007	0.008
	(0.39)	(0.40)	(0.47)
Illegitimate	-0.006	-0.007	0.005
	(-0.37)	(-0.37)	(0.29)
Parliamentary meeting	0.041**	0.042**	0.034*
	(2.82)	(2.83)	(2.26)
Ln(area)	-0.002	-0.002	-0.000
	(-0.18)	(-0.19)	(-0.03)
Spouse age			0.022***
			(10.34)
Spouse age 2			-0.001***
			(-9.75)
Spouse age 3			0.000***
			(8.13)
Constant	-0.225***	-0.224***	-0.167**
	(-4.28)	(-4.28)	(-3.06)
N	13641	13641	13641
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes
R2(adj)	0.091	0.091	0.122

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The table also shows that spouse age is strongly related to the probability of having additional children, first increasing rapidly and then falling slowly. On average, female spouses have the most children at age 23. However, spouse age is not significantly related to the risk of deposition (when controlling for monarch age), and the relationship between family size and deposition risk is therefore not affected by inclusion of spouse age as a control.

3.2 Natural deaths as outcome

To investigate whether large family size is an indicator of good health, we in this analysis set natural death as the dependent variable, and the family variables as independents. There are no statistically significant effects of family size on the likelihood of dying in a given year. Each additional family member is only associated with a decrease in probability of dying with 0.06 percentage points (the average risk is 3 percent), which indicates that the negative association between family size and deposition not is driven by the fact that individuals with larger families are healthier.

Table A10: Regression: Family size and natural death. All coefficients multiplied by 100.

	(1)	(2)	(3)
Family size	-0.066		
	(-1.38)		
Children		-0.117	
		(-1.74)	
Siblings		-0.004	
		(-0.05)	
Uncles and aunts		0.011	
		(0.09)	
Sons			-0.034
			(-0.26)
Daughters			-0.202
			(-1.52)
Brothers			-0.046
			(-0.31)
Sisters			0.017
			(0.14)
Uncles			0.041
			(0.14)
Aunts			-0.008
			(-0.04)
Female	1.329	1.427	1.450
	(1.60)	(1.71)	(1.73)
Married	-0.347	-0.292	-0.299
	(-0.82)	(-0.68)	(-0.70)
Primogeniture	0.319	0.352	0.354
	(0.62)	(0.68)	(0.68)
Illegitimate	-0.824	-0.728	-0.779
	(-0.78)	(-0.68)	(-0.72)
Parliamentary meeting	0.435	0.418	0.443
	(0.82)	(0.77)	(0.82)
Constant	-1.554	-1.741	-1.759
	(-0.93)	(-1.04)	(-1.04)
N	13641	13641	13641
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes
R2(adj):	0.035	0.035	0.034

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.3 Split sample on eventual age at death

To further account for unobserved health-related characteristics, we split the sample on the monarch's eventual age of death, at the first and fourth quartiles. This is problematic, as monarch's that are killed in connection with a deposition exit the sample, meaning that monarchs who survived until old age are a biased sample. Nevertheless, we still se the same association between family size and reduced risk of deposition both within the young and old sample. Due to the drastic reduction in sample size, country fixed effects are not included in this analysis.

Table A11: Regression: Family size and deposition, sample split on monarch's eventual age of death. All coefficients multiplied by 100.

	(1)	(2)	(3)
	Full sample	Died old (>= 65)	Died young (< 47)
Family size	-0.147***	-0.147*	-0.236*
	(-4.87)	(-2.20)	(-2.19)
Female	-0.575	-0.361	-0.449
	(-1.14)	(-0.25)	(-0.26)
Married	-0.051	0.741	0.590
	(-0.19)	(1.90)	(0.76)
Primogeniture	-1.699***	-1.865**	-3.738***
	(-5.64)	(-3.02)	(-3.87)
Illegitimate	0.693	0.119	-0.616
	(0.88)	(0.30)	(-0.31)
Parliamentary meeting	-0.302	-0.072	0.406
	(-1.07)	(-0.13)	(0.47)
Constant	3.320**	-0.451	9.900**
	(2.78)	(-0.25)	(2.93)
N	13641	3493	3376
Age controls:	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes
Century fixed effects:	No	No	No
Country fixed effects:	Yes	Yes	Yes
R2(adj):	0.014	0.028	0.020

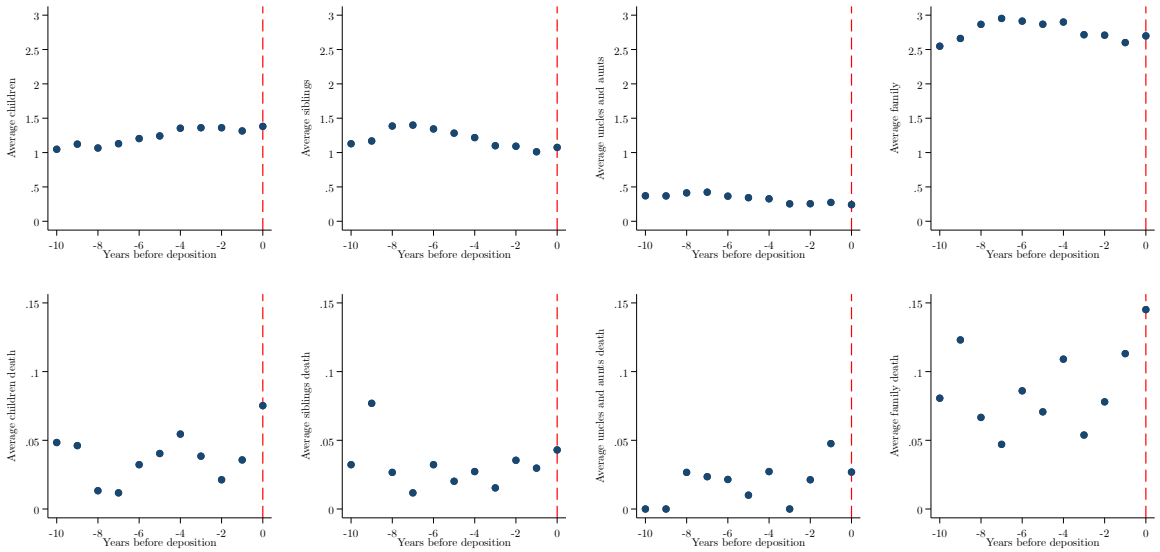
t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.4 Family deaths in advance of depositions

A possible source of endogeneity is that family members could be killed in advance of coups. To investigate if that is the case, we present the averages of the family variables in the years leading up to depositions for monarchs that were eventually deposed. The first row of the figure presents the averages of the variables used in the main analyses, that is, the number of children and siblings a monarch has each year.

The bottom row instead shows the average number of deaths among monarchs' relatives each year, in order to eliminate the possibility that deaths are offset by births.

Figure A2: Average number of children, siblings, paternal uncles and aunts (top row), and average number of deaths (bottom row) in the years leading up to the deposition, for monarchs that were eventually deposed.



In the bottom left figure, we can see that monarchs' children were somewhat more likely to die in deposition years, indicating that children were sometimes killed when their parents were deposed. However, the effect is relatively weak: 0.07 children on average. Furthermore, the children count variable we use in the analyses, which shows the number of children a monarch has each year, is only reduced the year after a child has died.

Children are counted from the year they are born until - and including - the year they die, as we for many children do not have information on the exact date of their death. The same is true for the other family variables. Deaths of family members in deposition years do thus not enter into the analysis, which is evident in the top row: The children count variable does not drop in the year of the deposition. It is thus unlikely that the results are driven by this type of endogeneity.

3.5 Regression with controls for deaths in the family and war

To account for the possibility that political instability could cause both the deposition of a monarch and the monarch having fewer children, we control for deaths in the family, and ongoing war, both civil and international, in previous years. The variables are the average of the number of deaths in the family, and years in which the state was involved in at least one war. The models are repeated using windows of both one and five years.

The descriptive statistics showed that there was little indication that family members died at elevated rates before depositions. Controlling for such deaths (Table A12) does not alter the conclusions from the main analysis. It is here important to keep in mind that the models control for the level of family members still alive. The death of a child thus affects the risk of deposition by decreasing the size of the family, but the death does not affect the deposition risk directly. There is a significant effect of sibling deaths, but it is negative, not positive as could be expected if instability was driving both reductions in family size and depositions. Possibly it could pick up the fact that holding current family size constant, more deaths in the last five years means that the family was larger previously, which could have an effect on stability now. It should also be pointed out that our measures of family size does not include the children of siblings. Siblings who have died may have had children - i.e. nephews and nieces - who have survived them and who can partially fulfill the same roles as siblings and children. When it comes to war (Table A13), the main conclusions remain unchanged. Although there is a positive effect of ongoing civil war - as can be expected - the coefficients for family size are not affected. And as family size can affect the incidence of civil war, controlling for the variables would imply a bias downwards.

Table A12: Regression: Control for deaths in the family. Coefficients multiplied by 100.

	(1)	(2)	(3)	(4)
	1 year	5 years	1 year	5 years
Family size	-0.135***	-0.133***		
	(-4.34)	(-4.28)		
Children			-0.115**	-0.121**
			(-3.17)	(-3.26)
Siblings			-0.209***	-0.202***
			(-3.63)	(-3.54)
Uncles and aunts			-0.022	-0.022
			(-0.29)	(-0.29)
Female	-0.817	-0.826	-0.902	-0.940
	(-1.47)	(-1.49)	(-1.61)	(-1.68)
Married	-0.131	-0.130	-0.159	-0.171
	(-0.46)	(-0.45)	(-0.55)	(-0.59)
Primogeniture	-1.624***	-1.622***	-1.630***	-1.641***
	(-3.93)	(-3.92)	(-3.94)	(-3.97)
Illegitimate	0.910	0.899	0.804	0.754
	(0.97)	(0.96)	(0.85)	(0.80)
Parliamentary meeting	0.027	0.030	-0.003	0.009
	(0.07)	(0.08)	(-0.01)	(0.03)
Family deaths$_{t-1}$	0.058			
	(0.25)			
Family deaths$_{t-5—t-1}$		-0.155		
		(-0.30)		
Children deaths$_{t-1}$			0.019	
			(0.07)	
Sibling deaths$_{t-1}$			-0.482	
			(-1.67)	
Children deaths$_{t-5—t-1}$				0.367
				(0.49)
Sibling deaths$_{t-5—t-1}$				-1.569**
				(-2.61)
Constant	2.681	2.677	2.595	2.708
	(1.82)	(1.82)	(1.75)	(1.83)
N	12918	12918	12918	12918
Age controls:	Yes	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes	Yes
R2(adj)	0.016	0.016	0.016	0.016

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A13: Regression: Control for ongoing war in preceding years. Coefficients multiplied by 100.

	(1)	(2)	(3)	(4)
	1 year	5 years	1 year	5 years
Family size	-0.118***	-0.120***		
	(-3.90)	(-3.91)		
Children			-0.108**	-0.110**
			(-2.89)	(-2.90)
Siblings			-0.176**	-0.174**
			(-3.20)	(-3.13)
Uncles and aunts			-0.015	-0.022
			(-0.20)	(-0.28)
Female	-0.657	-0.694	-0.704	-0.738
	(-1.22)	(-1.28)	(-1.29)	(-1.34)
Married	-0.069	-0.067	-0.083	-0.080
	(-0.24)	(-0.23)	(-0.29)	(-0.28)
Primogeniture	-1.462***	-1.485***	-1.461***	-1.483***
	(-3.58)	(-3.64)	(-3.56)	(-3.62)
Illegitimate	0.823	0.806	0.761	0.748
	(0.90)	(0.88)	(0.83)	(0.81)
Parliamentary meeting	0.079	0.128	0.047	0.098
	(0.22)	(0.36)	(0.13)	(0.27)
Civil war$_{t-1}$	3.316***		3.304***	
	(6.76)		(6.72)	
International war$_{t-1}$	0.074		0.069	
	(0.30)		(0.28)	
Civil war$_{t-5—t-1}$		3.408***		3.391***
		(6.31)		(6.26)
International war$_{t-5—t-1}$		-0.210		-0.217
		(-0.75)		(-0.77)
Constant	2.385	2.394	2.276	2.292
	(1.61)	(1.62)	(1.53)	(1.53)
N	12918	12918	12918	12918
Age controls:	Yes	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes	Yes
R2(adj)	0.025	0.024	0.025	0.024

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.6 Regression with lagged family variables

Table A14: Regression with lagged family variables. Coefficients multiplied by 100.

	(1)	(2)	(3)	(4)	(5)	(6)
	1 year	3 years	5 years	1 year	3 years	5 years
Family size$_{t-1}$	-0.133***					
	(-4.39)					
Family size$_{t-3}$		-0.112***				
		(-3.68)				
Family size$_{t-5}$			-0.078**			
			(-2.81)			
Children$_{t-1}$				-0.114**		
				(-3.16)		
Siblings$_{t-1}$				-0.221***		
				(-3.92)		
Uncles and aunts$_{t-1}$				0.014		
				(0.18)		
Children$_{t-3}$					-0.094**	
					(-2.61)	
Siblings$_{t-3}$					-0.172**	
					(-3.06)	
Uncles and aunts$_{t-3}$					-0.044	
					(-0.58)	
Children$_{t-5}$						-0.091**
						(-2.82)
Siblings$_{t-5}$						-0.094
						(-1.77)
Uncles and aunts$_{t-5}$						0.015
						(0.18)
Female	-0.823	-0.602	-0.495	-0.898	-0.664	-0.489
	(-1.48)	(-1.14)	(-1.03)	(-1.60)	(-1.24)	(-0.99)
Married	-0.150	0.048	0.063	-0.171	0.032	0.069
	(-0.52)	(0.19)	(0.27)	(-0.60)	(0.13)	(0.31)
Primogeniture	-1.622***	-1.224**	-1.032**	-1.622***	-1.234**	-1.016**
	(-3.93)	(-3.27)	(-2.84)	(-3.92)	(-3.26)	(-2.76)
Illegitimate	0.904	0.539	1.279	0.805	0.463	1.272
	(0.96)	(0.59)	(1.26)	(0.85)	(0.50)	(1.25)
Parliamentary meeting	0.024	-0.215	-0.509	-0.022	-0.240	-0.538
	(0.07)	(-0.61)	(-1.55)	(-0.06)	(-0.68)	(-1.63)
Constant	2.702	2.571	0.636	2.547	2.509	0.497
	(1.83)	(1.72)	(0.45)	(1.72)	(1.64)	(0.34)
N	12918	11594	10399	12918	11594	10399
Age controls:	Yes	Yes	Yes	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes	Yes	Yes	Yes
R2(adj)	0.016	0.011	0.008	0.016	0.011	0.008

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.7 Regression with different proxies

To further account for endogeneity issues, we have tried to find variables that could affect the risk of deposition through family size, without being affected by events during the monarch's reign that could give rise to endogeneity. While several of these cannot be said to satisfy the exclusion restriction in an instrumental variable analysis, we have entered them into the model as proxies, switching out the variables for family size.

The first variable is the accumulated years of marriage of the monarch. Monarchs that were married longer had more legitimate children. Using this variable reduces the risk that the association between family size and deposition is driven by frail monarchs having less children and being deposed more. Monarchs generally married early - the median age of first marriage is 22 - well before age-related diseases could begin to show.

Model 1 of Table A15 shows that years of marriage, just as family size, had a negative relationship with risk of deposition. Monarchs that had been married for longer, controlling for both age and tenure, were less likely to be deposed.

In models 2 and 3, we exchange the variables for living members of family used in the main analyses for the accumulated sum of births of members of family so far in the monarch's reign. Often this variable has the same value as the normal variable, but it is not reduced when children or siblings die. This means that an association with lower risk of deposition cannot be driven by the fact that family is killed in advance of depositions. The models yield similar results to the ones where living members of family are used.

Finally, in models 4 and 5, instead of the time-varying variables used earlier, we construct variables that count the number of members of family at the start of the monarch's reign. We see that monarchs that ascended the throne with more children and siblings were less likely to be deposed. This association can thus not be caused by events

during the reign. The number of paternal uncles and aunts does however not appear to matter, which is in line with the results of the main analysis.

Table A15: Regression with proxies. Coefficients multiplied by 100.

	(1)	(2)	(3)	(4)	(5)
Years of marriage	-0.037*				
	(-2.05)				
Sum of births of members of family		-0.100***			
		(-4.00)			
Sum of births of children			-0.107***		
			(-3.43)		
Sum of births of siblings			-0.201***		
			(-4.40)		
Sum of births of uncles and aunts			0.123*		
			(2.05)		
Family at start of reign				-0.112**	
				(-2.99)	
Children at start of reign					-0.146
					(-1.93)
Siblings at start of reign					-0.200***
					(-4.12)
Uncles and aunts at start of reign					0.106
					(1.75)
Female	-0.483	-0.789	-0.860	-0.778	-0.828
	(-0.89)	(-1.41)	(-1.52)	(-1.41)	(-1.49)
Married	0.084	-0.062	-0.037	-0.158	-0.136
	(0.29)	(-0.22)	(-0.13)	(-0.57)	(-0.50)
Primogeniture	-1.679***	-1.791***	-1.787***	-1.797***	-1.775***
	(-3.97)	(-4.23)	(-4.24)	(-4.20)	(-4.22)
Illegitimate	0.882	0.678	0.555	0.654	0.561
	(1.03)	(0.79)	(0.64)	(0.75)	(0.65)
Parliamentary meeting	-0.159	0.058	0.008	0.010	-0.072
	(-0.44)	(0.16)	(0.02)	(0.03)	(-0.19)
Constant	2.323	2.445	2.236	2.562*	2.331
	(1.83)	(1.92)	(1.75)	(2.01)	(1.82)
N	13641	13641	13641	13613	13613
Age controls:	Yes	Yes	Yes	Yes	Yes
Tenure controls:	Yes	Yes	Yes	Yes	Yes
Country fixed effects:	Yes	Yes	Yes	Yes	Yes
Century fixed effects:	Yes	Yes	Yes	Yes	Yes
R2(adj)	0.015	0.015	0.016	0.016	0.016

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4 An illustration of the mechanism

Our results point to family being a stabilizing factor for monarchs. There is little indication that sons, who in normal circumstances were the heirs, provided more security than other close relatives. It therefore seems more probable that the benefit of family came from the ability to use relatives as agents of the monarch, rather than as heirs. Unfortunately, this is hard to test directly using our dataset. However, we can provide an illustration focusing on England. Within our case universe, England makes up what in Seawright and Gerring's (2008) terminology is a typical case, that is, well-explained by the statistical model. Moreover, it is a case that commands particular attention in the literature. This means that it is ideal to further scrutinize the mechanisms of the general statistical relationship.

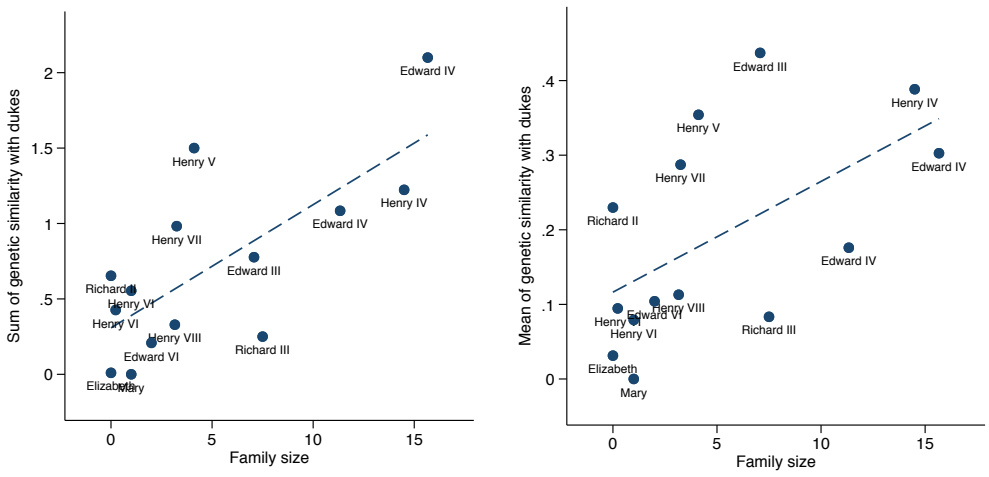
The highest title in the Peerage of England is that of Duke. Dukes held large amounts of lands and the associated incomes from these lands, and they could field armies (Given-Wilson 2002). As such, dukes were among the most powerful nobles in the realm. Having allies on these key positions was important for English monarchs, and the first dukes created, in the 14th century, were sons of Edward III. However, as the titles were hereditary, subsequent monarchs and dukes could "grow apart" in terms of their relation. Dukedoms could also be awarded to non-relatives.

We have mapped the relationships between all dukes and their monarchs from the reigns of Edward III to Elizabeth I, whose reign ended in 1603.[1] During her time, the last duke died, and no new titles were created until the time of her successor, after which the number of dukes increased markedly, up to around thirty. Between Edward and Elizabeth, the mean number of concurrent dukes were 2.6. The dukes are categorized

[1] Using Lundy (2010).

according to the coefficient of relation, which shows the average proportion of DNA shared between relatives. It is 0.5 for parents/children and between siblings, 0.25 for uncles/nephews, 0.125 for first cousins, 0.0625 for second cousins, and so on (Saggar and Bittles 2008). In Figure A3, we plot this coefficient for all dukes against the average family size of each monarch's reign. The left panel shows the sum of the coefficient for all dukes and the right graph the mean.

Figure A3: Relationship between monarchs' family sizes and relationship with dukes.

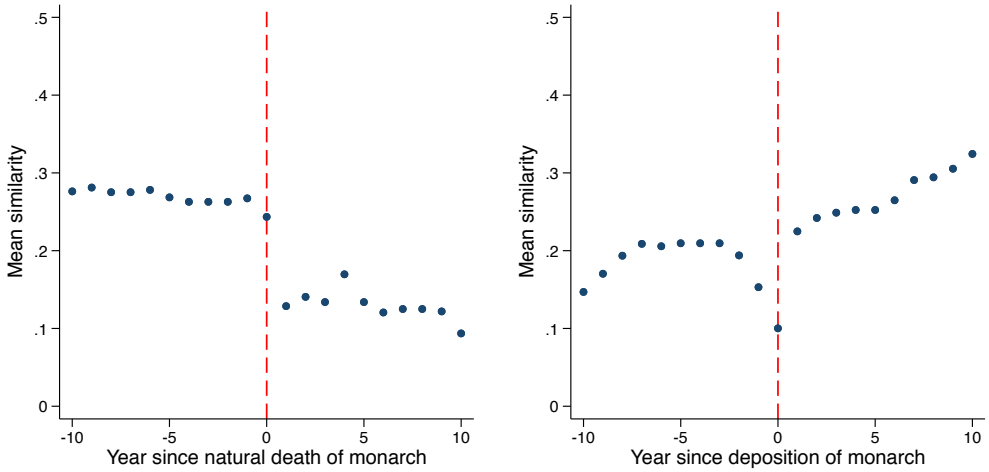


Monarchs with larger families were obviously more related to the most powerful nobles in the land, both on average (right panel) and in total, as monarchs with larger families could create additional dukedoms. There were of course other important nobles, such as earls, and from this graph, we know nothing about their various functions and responsibilities. However, as most important posts were held by nobility, it is certain that dukes wielded considerable influence, and we can see that monarchs with more children

and siblings had closer bonds to these powerful figures.

Figure A4 shows the mean coefficient of relation between monarchs and dukes before and after natural deaths of monarchs, as well as before and after depositions. Even though the sample sizes are very small, we see that the coefficient drops after a natural death, which is as expected given that if a son inherits the throne, the brothers of the previous king will become uncles of the next, and so on. However, we do not see the corresponding drop for depositions, reflecting the fact that usurpers generally wanted to place their own relatives in positions of power. This could be done by creating new dukedoms or by taking away the titles of dukes (e.g. on the charges of treason) and rewarding them to supporters.

Figure A4: Relationship between monarchs and dukes before and after natural deaths and depositions of monarchs.



The patterns correspond to well-known historical facts (we have already mentioned other examples from Capetian France), and they serve to illustrate that relatives indeed

often held important titles. Similar strategies of granting royal relatives dukedoms (or related titles) existed in other realms as well. However, to further test whether this also led to a reduction in the risk of a deposition, larger sample sizes are needed.

References

Given-Wilson, Chris (2002). *The English nobility in the late Middle Ages: the fourteenth-century political community*. Routledge.

Kokkonen, Andrej and Jørgen Møller (2020). "Succession, power-sharing and the development of representative institutions in medieval Europe". In: *European Journal of Political Research*.

Lundy, Darryl (2010). *The Peerage*. URL: `http://thepeerage.com`.

Saggar, Anand K and Alan H Bittles (2008). "Consanguinity and child health". In: *Paediatrics and Child Health* 18.5, pp. 244–249.

Seawright, Jason and John Gerring (2008). "Case selection techniques in case study research: A menu of qualitative and quantitative options". In: *Political research quarterly* 61.2, pp. 294–308.