May the King Live For Ever:

A Statistical Analysis of Stress from Reign Change in Imperial and Non-Imperial Polities

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Empires

A great many states and polities throughout history have described themselves, or have been described by others, as 'empires'. The most recent formal example is as near as the last quarter of the twentieth century, with the self-styled Central African Empire (1976-79). In their work *Empires in World History*, Burbank and Cooper define empires as 'large political units, expansionist or with a memory of power extended over space, polities that maintain distinction and hierarchy as they incorporate new people',[2] a definition that develops somewhat that of the Oxford English Dictionary: 'a supreme and extensive dominion, especially that exercised by a sovereign state over its dependencies' or 'an extensive territory (especially an aggregate of states) under the sway of an emperor or supreme ruler'.[3] Finer[4] links empire to size and a core ethnic group, while Goffman and Stroop[5], Lal[6], Colas[7] and Munkler[8] all put forward discussions that

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[2] Jane Burbank and Frederick Cooper, *Empires in world history: Power and the politics of difference* (Woodstock: Princeton University Press, 2010), p. 8.

[3] J.A. Simpson and E.S.C. Weiner (ed.) *Oxford English Dictionary* (Oxford: Clarendon Press, 1989)

[4] S.E. Finer, *The History of Government Volume I Ancient Monarchies and Empires* (Oxford: Oxford University Press, 1999), p. 8.

[5] Daniel Goffman and Christopher Stroop, 'Empire as Composite: the Ottoman Polity and the Typology of Dominion' in Elizabeth Sauer and Balachandra Rajan (eds.) *Imperialisms: Historical and Literary investigations 1500-1900* (Basingstoke: Palgrave Macmillan, 2004), 129-145.

[6] Deepak Lal, *In Praise of Empire (*(Basingstoke: Palgrave, 2004).

[7] Alejandro Colas, *Empire* (Cambridge: Polity Press, 2006), p. 6.

[8] Herfried Munkler, *Empires* (Cambridge: Polity Press, 2007) p. 4.

relate to size, expansion, hierarchy and rule, although Lal[9] emphasises the diversity of empire with mention of polarities that leave twelve different sorts of empire possible.

None of these definitions would well encompass the Central African Empire, although its self-designation, like the Mexican Empire (1822-1823), probably reflected the aspirations of its ruler more than the nature of the state. Burbank and Cooper are thus working to a fairly standard definition. The empires that they consider in more depth include Rome, China, Byzantium, Islamic caliphates such as the Ummayyids, Abbasids, and Fatimids, Mongol empires such as the Chinggisid, Yuan, Chagatai, Ilkhan, Timurid and Golden Horde, and Turkish polities such as the Ottomans and Seldjuks. They also emphasise religion as an important cultural and political characteristic impacting on the cohesion of imperial societies, either enhancing or reducing the imperial ability to hold its subjects together.[10] Another major characteristic, principally but not uniquely in Islamic cultures, is the use of slaves as soldiers, which has resulted, in some cases such as the Mamluk and Delhi empires, in the slaves acquiring sufficient power to displace the original rulers and to become the rulers themselves.[11] The steppe nomads and their empires are treated separately by Burbank and Cooper, reflecting the different military and cultural basis of such powers. In other words, as Lal points out, empires are very disparate.

Summarising the impact and interaction of such a wide range of factors is not easy. Burbank and Cooper take four chapters and over one hundred pages to address the matter in respect of about fifteen pre-modern empires. A small range of statistical measures would be helpful to supplement qualitative studies such as those of Burbank and Cooper. The use of numerical variables for the analysis of history is widespread at all levels, from the imperial and political

[9] Lal, p. 206.
[10] Burbank and Cooper, p. 17.
[11] Burbank and Cooper, p. 136.

(Turchin[12]) to the individual (Eisner,[13]), and there are journals such as *Cliodynamics* devoted to the development of a science of history which can be quantified. This paper aims to show how one such numerical measure, in conjunction with qualitative understandings, can be applied to a range of polities, imperial and otherwise, in order to identify significant differences and to offer lines of explanation.

The Days of the King

The Psalmist appeals to God 'Increase the days of the king's life, his years for many generations.'[14] This reflects one ongoing concern for ancient peoples, namely the length of reign enjoyed by the ruler. It is not difficult to see why this might be so. In any time or place, the end of a ruler's period in office imposes on the state or polity the risk associated with change. Even when the change occurs according to accepted procedures at an anticipated time, the revised policies and practises approved by the new ruler may not be an improvement, and, furthermore, the attempt to affect the modifications may not work as intended. Changes resulting from unanticipated adjustments and unaccepted procedures are even riskier and may well plunge the state into instability. Where the change is mediated by conquest, civil war, coup, assassination and/or intrigue, the instability is likely to be worse and can become worse still when change occurs frequently.

Realms of all sizes confront the problem of change at the end of a reign, and hence it is hardly surprising that the passing of rulers forms a major component of annals, chronologies and histories. A sample of 4,991 reigns, drawn from a range of states and polities from West Africa

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[12] Peter Turchin, *Historical Dynamics: Why States Rise and Fall.* (Princeton: Princeton University Press, 2003); *War and Peace and War* (London: Penguin, 2006); 'A theory for formation of large empires', *Journal of Global History,* 4, 2 (2009), 191-217; *Ultra Society: how 10,000 years of war made humans the greatest cooperators on Earth* (Chaplin Connecticut: Beresta Books, 2016).

[13] Manuel Eisner, M. 'Killing Kings: Patterns of Regicide in Europe, AD 600–1800', *British Journal of Criminology* 51 (2011), 556–577.

[14] *NIV Study Bible New International Version with Study Notes and References, Concordance and Maps* (London: Hodder and Stoughton, 1987), Psalm 61, 6.

to Mongolia in the period 1250 BC to 1520 AD (1850 AD in sub-Saharan Africa), was collected for this paper from a variety of sources, but principally Baumer[15], Bosworth[16], Paludan[17], Tapsell[18], and Venning[19]. It includes all of the groups and dynasties cited above and many more. A very wide range of polities and inheritance practices are included. Some rulers, such as the Papacy[20], generally required meaningful election by their peers, while others, such as Roman emperors, mostly received no more than formal ratification by a council or senate. Some were selected on a basis of primogeniture, others by predecessors' nomination. Such a range of practices makes it likely that differences will be identifiable. The handling of issues such as co-rulers and usurpers follows that of the source author, except that each period of an interrupted reign such as that of Justinian II or Zoe the niece of Basil II is always treated as a separate reign where identifiable. Changing back to a former way of doing things is still change.

The sample was found to have average reign duration of 13.27 years (standard deviation 12.63) although this varies considerably by period, polity-type and region, as will be shown below. The results may be calibrated against the findings of Eisner, based on a sample of 1,563 European monarchs in the period 600-1800 AD, with a reign length of 14.5 years (standard deviation 13.2). Clearly, there is considerable similarity in the data, although the difference is statistically significant due to the very large samples. From the present sample, a Reign Change measure has been devised, to give a possible indication of the associated level of stresses for each reign by

[15] Christoph Baumer, *The History of Central Asia: The Age of the Silk Road* (London: IB Tauris & Co Ltd, 2014); *The History of Central Asia: The Age of Islam and the Mongols* (London: IB Tauris & Co Ltd, 2016); *The History of Central Asia: The Age of the Steppe Warriors* (London: IB Tauris & Co Ltd, 2016).
[16] Clifford Bosworth, *The Islamic Dynasties: a Chronological and Genealogical Handbook* (Edinburgh: Edinburgh University Press, 1980); *The New Islamic Dynasties: A Chronological and Genealogical Manual. The New Edinburgh Islamic Surveys* (Edinburgh: Edinburgh University Press, 1996).
[17] Ann Paludan, *Chronicle of the Chinese Emperors: The Reign by Reign Record of the Rulers of Imperial China* (London: Thames & Hudson, 1998).
[18] R.F. Tapsell, *Monarchs, Rulers, Dynasties and Kingdoms of the World* (New York: Facts on File Publications, 2013).
[19] Timothy Venning, *The Kings & Queens of Anglo-Saxon England* (Stroud: Amberley Publishing, 2013).
[20] As with Eisner (2011), the Papacy is included in the sample. This reflects their claim to wield secular power after the fall of Rome.

comparing the reign length to the sample average length in a manner such that shorter reigns give rise to higher values:

Mean reign duration / Reign Duration x 2

The result was truncated to a maximum value of 120, in order to prevent skewing of results by the very high values generated by very short reigns, which may in fact lack the capacity to impose much stress on a realm by the very reason of their shortness. This maximum value of 120 corresponds to a reign length of 2.65 months (with only 7 out of 4,991 cases requiring such constraint).The seven days' reign of Zimri in Israel (whose untruncated score would be 692) was unlikely to have induced as much stress in the realm as would have nineteen or twenty successive nine month reigns (whose cumulative value would be about the same). The latter scenario is more akin to the situation prevailing in the Roman Empire in the mid-3rd century, where a succession of short-reigning emperors and numerous usurpers gave rise to instability. The score for the average reign length of European monarchs in Eisner's sample is 1.83 (rather than 2.00 as in this sample). Table 1 shows the way that the measure indicates increasing change, as a single 50 year reign generates a change level of 0.53 (which is 0.01 per year), but a similar period filled with reigns of 9 months generates a cumulative change of 2,872 (57.44 per year).

Table 1. Reign Change Measure by reign length

Reign Length	**Reign Change Measure A**	**Reigns in 50 year Period (rounded) B**	**Total Reign Change of the Period A x B**
50 years	0.53	1	0.53
12 years	2.21	4	8.84
3 years	8.85	17	150.45
9 months	35.4	67	2,871.80

Analysis

Table 2 shows that the average change measure for the entire sample is 9.6, with non-imperial polities and groups having an average of 8.8, compared with the average of 12.5 for the imperial groups. Given the large sample, this difference is statistically significant, but it is notable that there is considerable variation between the different states and polities designated as imperial. At one extreme, the third century AD of the Roman Empire recorded an average change measure of 34.0, the Mamluks of Egypt scored 24.0 and the 2nd Turkic Khanate averaged 22.4. At the other extreme, the West Han had a change measure of 3.0, Assyria of 3.2 and the Merovingians of 3.4, suggesting that these were prone to substantially less stress from reign end, although it should be noted that neither Assyrians nor Merovingians could be considered exempt from civil war.

The Roman Principate, despite considerable periods of stability, experienced bouts of civil war, thus leading to its higher average of 19.0, prior to the prolonged and nearly fatal outbreak of endemic civil war that occurred in the third century AD when the measure reached 34.0. The Early Byzantine empire (395–641 AD) and the Later Roman Empire (284-395 AD) show much less reign change than this, with very similar scores (7.2 and 7.3), suggesting a strong degree of continuity in the east, which was not found in the west, where during the fifth century the Roman Empire again experienced much more change (21.8) on its way to final collapse in 476 AD. After the rise of Islam and the loss of the provinces beyond Anatolia, the Byzantine empire began to score more highly, at 10.6 in the period 641-1071 AD (up to the defeat of the Battle of Manzikert), 10.0 in the period 1071-1204 AD (prior to the capture of Constantinople by the Fourth Crusade) and 11.0 in the period 1204-1453 (ending with the capture of Constantinople by the Ottomans). These results suggest that with the exception of the last century of the united empire, Rome experienced shorter reigns, and hence greater stress, than Byzantium. Although assassination, coup, civil war, and support of the army and civil authorities all remained

important factors in Byzantium with regards to succession, dynastic claims seem to have been stronger.

Table 2. Reign Change Index by Imperial status and polity/group

Status	Group	Mean	N
Non-Imperial	All Reigns	8.8	3,963
Imperial	Rome 3rd Century AD	34.0	35
	Mamluk	23.8	62
	2nd Turkic Khanate	22.4	11
	Rome 5th Century AD	21.8	14
	Timurids	21.2	19
	1st Turkic Khanate	19.3	9
	Rome Principate	19.0	23
	Golden Horde	18.7	55
	Delhi Sultans	17.1	38
	Umayyid	16.8	14
	Sasanids	16.1	36
	Chagatai	14.6	25
	Almoravids	13.9	7
	Later Tang	13.1	4
	East Turk Khanate	12.8	8
	Neo-Babylonian	12.4	6
	Parthian	11.8	39
	Seljuks of Rum	11.1	27
	Early Tang	11.1	13
	Byzantine 1204-1453	11.0	7
	Ayyubids	10.6	43
	Byzantium 641-1071	10.6	43
	Byzantium 1071-1204	10.0	28
	Ilkhanate	9.9	9
	Abbasid	9.9	42
	Sui	9.9	3
	Babylon	9.9	52
	East Han	9.8	12
	White Horde	9.1	12
	Ottoman	7.8	15
	Achaemenid	7.3	19
	Rome Later Empire (284-395 AD)	7.3	25
	Almohads	7.3	15
	Byzantium 395-641	7.2	15
	South Sung	7.1	9
	Hsiung Nu	6.4	47
	Holy Roman Empire	6.0	42
	Genghis Khan	5.1	13
	North Sung	4.7	9
	Ming	4.7	11
	Late Tang	4.0	10
	Fatimids	3.8	15
	Merovingian	3.4	32
	Assyria	3.2	41
	West Han	3.0	14
Imperial	All Reigns	12.5	1,028
All Reigns	All Reigns	9.6	4,991

Sources: Based on data drawn from Baumer (2014, 2016), Brook (2010), Bosworth (1980, 1996), Dignas & Winter (2007), Kuhn (2009), Paludan (1998), Rowe (2009), Sturlason (1930), Tapsell (1980), Venning (2013).

Seven cases were constrained to a maximum value of 120.

The Mamluks (23.8) and Delhi Sultanate (17.1) both have high scores, which may reflect the slave dynasties in these polities, with a high frequency of coups and adult successors drawn from the slave-based army. The sons of Mamluks generally were regarded as less militarily capable, which probably hindered the child of a Sultan in establishing a claim to power. By contrast, the Ottomans, despite their extensive use of the devirshme and Christian slaves from the Balkans, drew their rulers from a single small dynasty that was subject to purge at many successions, and so the reign scores were much lower (7.8). Nomad dynasties also contribute to the group of high scoring polities, as four of the top ten are identifiable nomads. Some ethnic groups such as Arabs (Umayyids – 16.8, Abbasids – 9.9) and Berbers (Almoravids – 13.9, Almohads – 7.3) also tend to have high scores.

Included in the non-imperial reigns are some other polities and groups with high mean change scores such as the Papacy in the period 476–1520 AD (mean change 14.7), Kiev (17.0), Novgorod (16.3) and some Celtic Irish polities (e.g. Meath mean 9.0 or Ulaidh mean 17.0). These results likely reflect particular aspects of the group, such as the practice of tanistry in Ireland, the repeated movement of Riurikid princes between Russian principalities or the election of (mostly) senior clerics in the Papacy which inhibited the succession of young rulers with greater likelihood of long reigns, and promoted the frequent replacement of older rulers.

Table 3 shows that there is a possible connection between religion and change. There are twenty religions identified, from Roman pagan (24.7), Judaism (16.8) and Christian (14.1) to Buddhist (2.2). Of those eight religions represented in both imperial and non-imperial polities, five have less change in the non-imperial polities. Some of this is likely due to the social structure in which the religion operated (e.g. the rulers classified as pagan Roman and Christian were Roman emperors), but other differences may reflect the religion itself; for example, the change associated with Shia reigns (5.3) being less than that of Sunni polities (10.7). Shia thinking

emphasises the descent of religious and political authority by inheritance from the nephew of the Prophet Mohammed to imams, which sets the context for the view of a Shia commentator in the 13th Century AD that 'This means that any action intended to oppose the Imam to prevent him from occupying his office etc is to be considered a great sin' [21](quoted by Williams, 1971, p40). This attitude may have led to a greater opportunity for young rulers to inherit successfully from their fathers, and to reluctance to remove existing imams or caliphs. There is, perhaps, the possibility that the struggle for power was displaced downwards in the hierarchy.

Table 3. Reign change Measure by Religion

Status	Non-Imperial		Imperial		All		Less Reign Change
Religion	Mean	N	Mean	N	Mean	N	
Pagan Roman	-	-	24.7	70	24.7	70	-
Judaism	16.8	38	-	-	16.8	38	-
Christian	-	-	14.1	27	14.1	27	-
Zoroastrian	1.9	14	13.1	55	10.8	69	N
Orthodox	11.1	294	9.8	86	10.8	380	-
Sunni	9.4	1,539	16.8	317	10.7	1,856	N
Pagan Greek	9.5	28	-	-	9.5	28	-
Confucianism	12.6	60	6.9	85	9.2	145	I
Pagan Animist	7.9	122	10.3	132	9.2	254	N
Manicheaism	9.0	7	-	-	9.0	7	-
Sunni sect	7.2	11	9.4	22	8.7	33	N
Catholic	8.7	1,209	5.5	80	8.5	1,289	I
Pagan	7.5	318	8.5	139	7.8	457	N
Shia	5.4	220	3.8	15	5.3	235	I
Hindu	4.4	25	-	-	4.4	25	-
Pagan Egyptian	3.8	44	-	-	3.8	44	-
Shia sect	3.1	6	-	-	3.1	6	-
Pagan Celt	2.3	18	-	-	2.3	18	-
Buddhist	2.2	10	-	-	2.2	10	-
Total	8.8	3,963	12.5	1,028	9.6	4,991	N

Sources: Based on data drawn from Baumer (2014, 2016), Brook (2010), Bosworth (1980, 1996), Dignas & Winter(2007),Kuhn (2009), Paludan (1998), Rowe (2009), Sturlason (1930), Tapsell (1980), Venning (2013).

[21] John Alden Williams, *Themes of Islamic Civilisation.* (Berkley: University of California Press, 1971), p. 40.

Seven cases were constrained to a maximum value of 120.

The category of 'Christian' relates to Roman emperors from Constantine to Theodosius, prior to the final partition of the Empire in 395 AD into West (Latin and ultimately Catholic) and East (Greek and ultimately Orthodox).

N The Non-imperial reigns have lower reign change (6 of 9).

I The Imperial reigns have less reign change (3 of 9).

Given that there are established links between mortality and climate though the biological effects of climate on humans[22], it is reasonable to test for any evidence of this in the sample. Table 4 shows that the means are higher in cool (10.6) or hot environments (9.2) than in warm (8.7), cool being higher than hot. This is a finding compatible with the findings of Liddell et al. on general mortality. In cool and warm environments, arid conditions have higher change measures than humid, while in hot environments, the opposite is the case. Although the differences are small by comparison with many of the other differences noted, they are nonetheless statistically significant. (ANOVA test at 95 percent significance, with F value of 10.34). Climatic change, as opposed to general climate conditions, may also be of significance as a source of stress, but the assembly of climate change date for nearly five thousand rulers during a period of over two thousand years in an area from West Africa to Mongolia is a very substantial project.

Table 4. Reign change measure by the climate of region

Mean annual temperature ºC	**Rainfall**					
	Arid (Under 500 mm pa)		**Humid (500 mm pa or more)**		**All**	
	Mean	**N**	**Mean**	**N**	**Mean**	**N**
Cool (under 10)	11.18	306	10.85	1,478	10.91	1,784
Warm (10 but under 20)	8.85	1,513	8.14	585	8.65	2,098
Hot (20 and above)	9.02	943	10.47	166	9.23	1,109
All	9.17	2,762	10.11	2,229	9.59	4,991

Sources: Based on data drawn from Baumer (2014, 2016), Brook (2010), Bosworth (1980, 1996), Dignas & Winter (2007),

[22] Christine Liddell, Chris Morris, Harriet Thomson and Ciara Guiney, 'Excess winter deaths in 30 European countries 1980–2013: a critical review of methods', *Journal of Public Health*, Volume 38, Issue 4 (December 2016), 806–814. <https://doi.org/10.1093/pubmed/fdv184>. Accessed 12/09/18.

Kuhn (2009), Paludan (1998), Rowe (2009), Sturlason (1930), Tapsell (1980), Venning (2013).

Seven cases were constrained to a maximum value of 120.

Another possibility is that reign length may be linked to the ruler's position in the dynasty; that is, whether the ruler reigned at the start or the end of the dynasty. It commonly happens that a long reign is followed by a series of short reigns as elderly successors die soon after succession, and younger heirs and others manoeuvre for advantage. An example of this is described by Michael Psellus[23] where the Byzantine Emperor Basil II ruled, generally successfully, for 52 years (976-1028 AD, with a mean change of 0.5), while his eleven successors reigned during a period of 43 years (1028-1071 AD, mean change of 9.2) that lost the advantages gained by Basil and culminated in the critical defeat of the Byzantines by the Seljuk Turks at Manzikert in 1071 AD.

Given the indications that a number of factors appear to be contributing to the results, it is necessary to attempt to separate out explanatory variables from others which are simply correlated with explanatory variables (as already noted, the high scores for pagan Roman and Christian emperors may perhaps be better explained by the society to which they belonged rather than their religion). Accordingly, a stepwise linear regression was applied to explain Reign Change using 17 categorical variables (0 or 1) and the continuous variable Dynasty Position (0.0-1.0)[24], using variables explored or suggested above[25]. Table 5 shows that the regression found that 11 of the variables were found to make statistically significant contributions to explaining Reign Change. In order of the strength of their contributions, these were Slave Dynasty, Dynasty Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish, Russia, Imperial, and Shia. On the other hand, Humid and Hot Climates, Nomad lifestyle, Orthodox religion and

[23] Michael Psellus. *Fourteen Byzantine Rulers*, trans. E.R.A Sewter (Harmondsworth: Penguin Classics, 1966).
[24] Position is calculated as number of the reign within the dynasty (e.g, first, second etc) / total number of reigns occurring in the dynasty and lies in the range 0.0-1.0
[25] These variables are: Slave Dynasty, Dynasty Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish, Russia, Imperial, Shia, Humid Climate, Hot Climate, Nomad, Orthodox, Turk, Arab and Berber.

Turk, Arab and Berber ethnicity are not statistically significant, although the last approaches considerably closer to the statistical limit than the others.

It should be noted that the model separates the effects of the Papacy (increased score) from Catholicism in general (reduced score), even though the Pope is a Catholic. Though Ireland and Russia are both classed as Cool Climates, the model distinguishes between the effects of cool climate and society, with both being significant variables.

From the model, one would expect an imperial Sunni Slave dynasty to have a Reign Change Score of 20.2, which in fact lies between the actual scores of the Mamluks (23.8) and Delhi Sultanate (17.1). An Imperial status does contribute significantly to Reign Change, but it is by no means the largest effect, adding 34% to the expected level of change, whereas Sunni religion adds 48% and a slave dynasty adds 280%. The Catholic and Shia religious affiliations are both noteworthy in that they are the only two factors, out of eleven, the inclusion of which reduces Reign Change in the model (by -87% and -49% respectively). An explanation of this for Shia polities, namely the emphasis on personal inheritance of political and religious authority from the Prophet's nephew, has already been proposed. It is less clear why Catholic polities show an even stronger reduction, but it may also be due to hereditary succession.

(See next page for table.)

Table 5. Regression of Reign Change Measure

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.124	0.015	0.015	15.59230
2	.157	0.025	0.024	15.52178
3	.178	0.032	0.031	15.46694
4	.193	0.037	0.037	15.42237
5	.210	0.044	0.043	15.37029
6	.224	0.050	0.049	15.32332
7	.230	0.053	0.051	15.30287
8	.233	0.054	0.053	15.29159
9	.237	0.056	0.054	15.28059
10	.239	0.057	0.055	15.27201
11	.241	0.058	0.056	15.26752
1. Predictors: (Constant), Slave Dynasty				
2. Predictors: (Constant), Slave Dynasty, Position				
3. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium				
4. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate				
5. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic				
6. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy				
7. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni				
8. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish				
9 Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish, Russia				
10. Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish, Russia, Imperial				
11 .Predictors: (Constant), Slave Dynasty, Position, Rome & Byzantium, Cool Climate, Catholic, Papacy, Sunni, Irish, Russia, Imperial, Shia				

Final Model to explain Reign Change Measure

Model 11 Variables	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	Percent change
(Constant)	4.381	0.624		7.024	0.000	
Slave Dynasty	12.248	1.629	0.112	7.519	0.000	280
Dynastic Position	5.419	0.748	0.100	7.244	0.000	124
Rome & Byzantium	5.703	1.259	0.070	4.529	0.000	130
Cool Climate	3.186	0.644	0.097	4.947	0.000	73
Catholic	-3.827	0.781	-0.107	-4.898	0.000	-87
Papacy	8.219	1.250	0.102	6.576	0.000	188
Sunni	2.047	0.577	0.063	3.548	0.000	47
Irish	3.262	0.947	0.059	3.444	0.001	74
Russia	4.957	1.602	0.047	3.094	0.002	113
Imperial	1.494	0.652	0.038	2.292	0.022	34
Shia	-2.166	1.092	-0.030	-1.983	0.047	-49

Table 5 (Continued). Regression of Reign Change Measure

Excluded Variables	Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
Humid Climate	.011[1]	0.516	0.606	0.007	0.396
Hot Climate	-.025[1]	-1.593	0.111	-0.023	0.774
Nomad	.010[1]	0.554	0.580	0.008	0.562
Orthodox	-.026[1]	-1.415	0.157	-0.020	0.547
Turk	-.006[1]	-0.352	0.725	-0.005	0.744
Arab	.007[1]	0.478	0.633	0.007	0.881
Berber	.028[1]	1.936	0.053	0.027	0.923

Sources: Based on data drawn from Baumer (2014, 2016), Brook (2010), Bosworth (1980, 1996), Dignas & Winter (2007), Kuhn (2009), Paludan (1998), Rowe (2009), Sturlason (1930), Tapsell (1980), Venning (2013).

Seven cases were constrained to a maximum value of 120.

Stepwise regression using SPSS.

Limitations of the Results

In combination, the eleven significant variables explain only 5.3 percent of the variance. This is a very small fraction of the whole, and makes it plain that a great deal remains to be explained. Death by natural causes is only considered here in terms of the impact of climate and, as already noted, climatic change as well as general climate may also be relevant. More generally, the circumstances of rulers would tend to expose them to a different spectrum of risks (less epidemics, more degenerative disease) to the generality of their subjects. Indeed, rulers in long established dynasties would tend to be exposed to risks of inbreeding and hereditary diseases that would scarcely concern elected princes and leaders of successful coups. Social environment also has an impact on risk of death by accident. A ruler secluded in an imperial palace is at less risk of hunting accidents than nomad khans and Norman kings. Importantly, however, Eisner demonstrates that European monarchs were more at risk from battle (6% of deaths) and murder (15%) than most of their subjects[26], suggesting that cultural and political factors relating to these causes should be examined in greater detail in future work.

Conclusions

Reign lengths are a generally underappreciated source of information for comparisons between groups, and between periods and regions, and this information is especially suited to quantitative methods. The statistical analysis of the Reign Change measure, derived from reign length, in a very large sample of reigns and polities shows that there are clear differences between various groups. Regression techniques allow the possibility of identifying the relative importance and statistical significance of these interacting factors. The difference between imperial and non-imperial polities, though real, is much less than other structural differences between polities, such as the differences between their various religions. The findings can probably be refined by identifying and including in the analysis, specific social mechanisms such as the use of coup and

[26] Eisner, *op cit.*

assassination as means of implementing succession, and heredity, tanistry and election to identify successors. An analysis of the risk of death by accident and natural causes for rulers in different environments might also be helpful.

The results also suggest that the presence/absence of a cool climate is probably more important than the imperial/non-imperial distinction. The death of a ruler by natural causes still triggers many of the stresses of change, and if people, even emperors, are more prone to die prematurely in cooler environments, it is reasonable to regard climate as an agent of social stress. The evidence suggests that it might perhaps be premature to dismiss as 'climatic determinism' those indications that climate impacts on history.

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