

# Sultans, the Shari'a and Seven Empty Ears: Economic Catastrophes, Church and State

Very preliminary, comments welcome

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August 13, 2009

## Abstract

This paper uses over 700 years of Nile flood data and a novel data set on the tenure of Egyptian political and religious leaders to investigate how economic shocks affected the balance of power between “church” and “state” in the pre-modern Muslim world. Results show that although political leadership was more likely to change hands during Nile failures, the highest ranking religious post was less likely to rotate during periods of economic distress. Additional empirical evidence is combined with the historical record to investigate the extent to which this pattern represents increased political influence. The paper concludes that Nile-induced economic crises appear to have improved the political bargaining position of Muslim religious authorities vis-à-vis the “state.”

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\*Harvard University. I thank CREI for hosting me while part of this project was carried out. Efraim Benmelech, Cemal Kafadar, Antonio Ciccone, Edhem Eldem, Guido Imbens, Joachim Voth and seminar participants at CREI provided helpful discussions and comments. I also thank Nadim Rabaia for research assistance and Alexander Ruzmaikin for graciously sharing the Nile data used in previous studies. The library staff at the Biblioteque National de France, Manuscripts Orientaux greatly facilitated the Nile data transcription. Any remaining errors are my own.

And Joseph said unto Pharaoh [...] the seven empty ears [...] shall be seven years of famine [...] [a]nd Pharaoh took off his ring from his hand, and put it upon Joseph's hand [...] and made [Joseph] ruler over all the land of Egypt [Genesis 41:25-43]

Until relatively recently, economists have neglected the role religious organizations play in determining political outcomes. This long neglect is somewhat surprising given Adam Smith's emphasis on the importance of the links between church and state for political stability and economic progress.<sup>1</sup> In his *Wealth of Nations* (1999 [1776]) he posits that in countries where there is an established religion "[t]he sovereign can [...] never be secure unless he has the means of influencing in a considerable degree the greater part of the teachers of [...] religion" (p. 385). Smith considered the bargaining power of the clergy an important determinant of the military strength and the wealth of nations (p. 402).

The burgeoning literature on the economic importance of institutional frameworks suggests Adam Smith may have been correct in stressing the relationship between church and state as a factor in determining economic outcomes.<sup>2</sup> In his Nobel lecture Douglas North (1994) stressed that institutions are usually created and modified to "serve the interest of those with the bargaining power to create new rules" (North 1994). Since religious organizations were historically often the most politically and economically powerful "interest" group outside the ruling political establishment (North et al. (2009), p. 39), religious organizations likely played (and may continue to play) an important role in determining institutional trajectories in many societies.

Economists have recently begun to investigate how religious organizations influence political and institutional outcomes. Murphy and Shleifer (2004) suggest that religious leaders may create networks and then "rent out" their networks to candidates. In return for political support, political leaders promote the religious beliefs of the networks. Glaeser et al. (2005) also examine the role of religious issues in politics.

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<sup>1</sup>For the economic literature on state stability and economics outcomes see Barro (1991), Rodrik (1991), Alesina et al. (1996).

<sup>2</sup>Representative papers in the literature include Engermann and Sokoloff (2002) and Acemoglu, Johnson and Robinson (2001).

Their model suggests that vote maximizing politicians may adopt “extreme” religious (or non-religious) positions to better mobilize their core constituencies. Results in Barro and McCleary (2005) show that changes in state religions occur simultaneously with those of political regimes. This result is consistent with synergies between political and religious elites. Results in Igiyun (2008) suggesting that Ottoman offensives in Europe led Christian powers to reduce interdenominational conflict are also consistent such synergies.<sup>3</sup>

While recent research provides growing evidence suggesting that religious organizations can affect political and institutional outcomes, little is known about the determinants of a given religion’s political influence. This paper uses over 700 years of Nile flood data and a novel data set on the tenure of Egyptian political and judicial leaders (who were also high-ranking religious authorities) to investigate how large economic shocks affected the political balance between church and state.

Results investigating the effect of Nile deviations on changes in the sultanate<sup>4</sup> are consistent with previous empirical work by Miguel et al. (2004) and the theoretical frameworks of Acemoglu and Robinson (2006) and North et al. (2009): the sultanate was roughly 20 percentage points more likely to change hands in years of abnormal Nile floods. The historiography suggests this was due to higher likelihood of civil war during periods of Nile failure.

A novel data set on the tenure of the highest ranking Muslim religious and judicial authority (*qadi al-qudat*) allows us to investigate the effects of Nile-induced economic catastrophes on the judiciary. These results show that the “cleric”-led judiciary was roughly 15 percentage points less likely to change hands in periods of Nile-induced economic distress.

Although data limitations do not allow us to pin down the exact causal channel through which abnormal Nile floods altered political outcomes, additional empiri-

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<sup>3</sup>For a recent investigation of the effects of religious organizations on state stability see Igiyun (2009).

<sup>4</sup>The use of sultanate is an abuse of terminology done in the interest of simplicity. During the almost 800 years of data, Egypt was ruled by caliphs, governors and sultans. Thus, sultanate throughout this paper refers to the ruling political regime irrespective of the nature of this regime.

cal evidence and the historical record suggest the results are indicative of greater “clerical” influence following abnormal Nile floods.

From an econometric standpoint, this study highlights the potentially devastating effects of measurement error for empirical studies that rely on historical data. The existence of two plausibly independent transcriptions of the Nile flood data allow us to assess the extent of measurement-error-induced downward bias in each error-ridden data set. The results are not encouraging. Had we attempted the empirical exercise with the most error-laden data set we would have obtained statistically insignificant point estimates approximately one-tenth their true value. As is the case using modern data, empirical results using historical data are likely to be attenuated. The results of this study, however, suggest that measurement error in historical data may often be so severe that important empirical relationships are empirically unidentifiable even if the relevant data do exist.

The remainder of the paper proceeds as follows. The first section briefly reviews previous hypotheses involving the political effects of the relationship between “church” and “state” in Islam and then outlines this relationship. The second section uses historical evidence to investigate how Nile failure affected the balance of power between church and state in pre-Ottoman Egypt. The third section describes the data, the extent to which Nile variation is exogenous and the timing of the Nile flood. The fourth section empirically investigates the effect of Nile failures on political outcomes. The fifth section uses empirical and historical evidence to weigh competing interpretations of the results. The sixth section concludes.

## **1 “Church” and “State” in Pre-Ottoman Islam**

Scholars have long hypothesized that Islam has dampened the development of political institutions in Muslim countries. This view goes back at least to Montesquieu who argued that Christian beliefs put “a break on despotism and unmitigated monarchy” whereas Islam encouraged the persistence of despotism (Israel (2006), p. 268).

More recently scholars have further developed this argument by stressing that

while Christianity differentiated from an early date between “God and Caesar”, Islam never managed to separate the two. This strong link between “church” and “state” has been blamed for a host of negative outcomes ranging from economic stagnation to the persistence of despotism in Muslim countries.

This section details how the religious hierarchy (which we will loosely define as the “church”) functioned in Islam and how it related to the state.

## 1.1 The Muslim “Church”

Islam has never had a strictly centralized hierarchy.<sup>5</sup> Rather, Islam is best characterized as a fairly decentralized nomocracy (or a religion ruled by law). This decentralization appears to have begun at an early stage as the behavior of political leaders deviated from Islamic ideals.

Following the death of the prophet Muhammad (632), his immediate successors (caliphs) appointed Qur’an readers and built mosques across the growing Muslim empire in an attempt to better indoctrinate the bedouin community. During this initial period “study groups” (halqa) spontaneously formed in mosques around pious and charismatic individuals. These individuals appear to have concentrated on understanding the implications of Muhammad’s message for human behavior and societal order. It was in these study groups that Muslim law and the religious hierarchy began to form.

Muslim law (shari’a) defined what was permitted and forbidden based on Muslim religious sources. Muslim law investigated both ritualistic matters (such as how one should pray) and strictly legal concerns (such as the validity of contracts).

After this formative period those trained in Muslim law composed the majority of Islam’s religious hierarchy.<sup>6</sup> This hierarchy largely developed outside the government’s control. Most Muslim religious institutions (such as mosques and *madradas*) were founded by private individuals through pious endowments of *waqfs* (Hallaq

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<sup>5</sup>This holds, at the very least, for pre-Ottoman Islam.

<sup>6</sup>We consider an individual part of the religious hierarchy if he is employed in Muslim religious institutions, or respected by the populace as someone with religious authority.

(2009), p. 146). The founder of the institution had the right to determine who ran the mosque or madrasa (al-Mawardi ()). Political leaders tended to endow the largest mosques and *madrasas*. Appointments in these institutions were generally made by the government appointed head judge.

Most officials in the religious hierarchy had studied Muslim law in a *madrasa* (Johansen (1999), p. 120, 121; Ephrat (2005), p. 89) although one could become a religious authority by virtue of one's piety, private study or charisma. This hierarchy was sustained by funds from the *waqfs* and fees charged for the issuance of legal opinions for private citizens. Religious scholars often supplemented these incomes with outside work (Lapidus (1984), p. 109, Hallaq (2009), p. 154).

The Islamic "Church" then, is best defined as a confederation of legists and other pious individuals who were supported by and embedded in their local communities.<sup>7</sup> These religious authorities were linked by common interests, beliefs, education and marital and family ties. The legal community also formed guild-like associations to help structure and regulate their associations. This Muslim "clergy" was "closely tied to [their communities] by strong economic as well as familial and ideological bonds [... and] shared [their communities'] problems and interests because many of them and their families were merchants or craftsmen" (Lapidus (1984), p. 139).

A prominent scholar of Muslim law has summarized the importance of these legists and their law for organizing local community life. He states that "the [organization] of society into schools and clienteles based on religious leadership [created] loyalties which cut across class lines [...] to unite the whole community and discourage special interests or particularistic and corporate ties" (Lapidus (1984), p. 105). For this reason, the Muslim "clergy" (legal profession) "served as an effective tool [to the political leaders] for reaching the masses from whose ranks they had emerged and whom they represented" (Hallaq (2009), p. 130).

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<sup>7</sup>Hallaq (2009).

## 1.2 The Relationship between “Church” and “State”

Wael Hallaq, a prominent scholar of Muslim law has summarized the relationship between the Muslim clergy and the “state” (the use of state is admittedly anachronistic and refers to those in control of the military and coercive forces) as follows:

[Those in power] could not penetrate the societies they ruled, nor could they regulate the internal affairs of their subject populations. [They] were generally concerned with monopoly over military and political power [...] and] could not administer their domains directly [...] the legal profession served as representatives of the [local populations]<sup>8</sup>

The Muslim clergy administered local justice and generally provided the glue that allowed “Muslim cities [to hold] together without recourse to more formal institutions of representation or control” (Lapidus (1984), p. 114).

Since local religious authorities held the key to local administration and popular support, the ruling elites sought to obtain their backing. This support, however, required a “substantial investment [...] on the part of these rulers in order to successfully coopt [the legal profession]” (Hallaq (2009), p. 149). To obtain their support, political authorities supported the Islamic “clergy” financially and empowered them politically.<sup>9</sup>

Political elites supported religious elites financially by endowing mosques and colleges. They politically empowered religious elites by adhering to Muslim law. Since the religious elites in Islam were the “custodians” of this law, they administered this law by holding highly paid state positions. Muslim religious elites received both monetary support and the coercive support of the political authority to help enforce Muslim law and to suppress heresy and competing organizational forms (Lapidus (1984) , p. 131).

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<sup>8</sup>Hallaq (2009), pp. 147-148

<sup>9</sup>Makdisi (1991), p. 45, Hallaq (2009), p. 130, 133, 152.

### 1.2.1 Muslim Law and Constraining the “State”

Although a detailed description of the evolution of Muslim legal practices is not possible here, by around the eighth century CE, the “state” had lost the ability to define and determine Muslim law. This separation between the law and state in Islam is described by a prominent scholar as follows:

[w]hereas law –as a legislated and executed system– was state-based in other imperial and complex civilizations, in Islam the ruling powers had virtually nothing to with legal governance or with the production and promulgation of law<sup>10</sup>

The “clergy” (jurists) alone had the authority to issue legal rulings, although lone jurists had no way to enforce their rulings. The state provided coercive force to implement these rulings by naming a state-appointed head judges who then appointed subordinate judges and oversaw the legal administration and ordering of Muslim society.

Upon appointment, the chief judge was theoretically independent of the political authority until dismissal.<sup>11</sup> In addition to appointing subordinate judges across the ruler’s domain, the head judge held a wide array of legal and extra-legal responsibilities.<sup>12</sup> These responsibilities included the appointment of the staff of state-run mosques and madrasas across the ruler’s domain. He was responsible for investing and divesting a given Caliph or Sultan following a change in power and pronouncing the ruler’s name in the Friday prayer (Shabārū 1998, p. 113). This pronouncement was seen as an endorsement of the ruler’s legitimacy and its omission was seen as an act of rebellion. The judge could also announce in the Friday sermon the need to mobilize for holy war (*jihād*) after which the congregation would prepare for war (Shabārū 1998, p. 120, 122).

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<sup>10</sup>Hallaq (2005), p. 166

<sup>11</sup>Hallaq (2005), p. 83

<sup>12</sup>For a detailed overview of the chief judge’s functions see Shabārū (1998).

## 1.2.2 The Choice of Head Judge and Constraining the State

The Islamic clergy appears to have often used their influence to act as break on arbitrary property confiscations and other infringements by the ruler. Ira Lapidus, a prominent historian, sums up the evidence to conclude that:

there were limits to the absorption of the ulama [clergy] into the state apparatus [...] [t]heir true destiny was to be intermediaries who not only negotiated, legitimized, and facilitated taxation, but also resisted, haggled, and defended against abuse. In principle they stood against confiscations without consent and proper compensation [...] Ulama also resisted the contention that all property belonged to the Sultan, and inveighed against the practice of eminent domain lapidus.<sup>13</sup>

On the one hand, then, a given ruler had an incentive to appoint as head judge a “yes man” who would implement his will. On the other hand, so doing alienated the clerics who had influence on the ground. Thus, in his appointment of head judge a ruler walked a fine line. Similarly, when deciding whether or not to obey the ruling of a head judge that went against their desires the rulers

weigh[ed] their overall gains and losses. To have accomplished their ends through coercion would have meant that their legitimacy had failed the test. On the other hand, total compliance with [Muslim] law at times meant that their quest for material gain or will-to-power would be frustrated. It was this equation that they attempted to work out and balance carefully, at times succeeding and at others failing.<sup>14</sup>

While information on the backgrounds of head judges are generally lacking, a detailed study of the factors behind the appointment of head judges during the mamluk period has revealed that political maneuvering, patronage and nepotism seem to have been the most common paths to the highest position in the judiciary.

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<sup>13</sup>Lapidus (1984), p. 140.

<sup>14</sup>Hallaq (2003)

A non-trivial amount of judges, however, appear to have been appointed because of their merit and personal influence (Escovitz (1984) pp. 75-81).

Despite political maneuvering, head judges appear to have generally retained “vast personal authority among the ulama and in the urban community, and their selection by the state served to vest a certain measure of influence over the ulama community in the hands of the Sultan. At the same time it conferred an additional degree of prestige on the chief qadis” (Lapidus (1984), p. 136).

In general after appointment the political rulers seem to have been largely disinterested in the daily details of legal decisions, leaving the head judge and his subordinates almost completely independent (Hallaq (2009), p.).

Legal decisions that directly affected the ruler’s payoffs, however, were more contested. The status of pious endowments (waqfs) appears to have been a frequent point of contention between the head judge and the rulers. Rulers at times tried to confiscate these endowments. Many legal scholars, however, depended on these endowments for their sustenance and worked at times worked with the head judge to resist such confiscations. Other documented points of contention involved the use of funds destined for orphans and the legality of high-ranking Christian and Jewish governmental appointments.

**Determinants of Judge’s Ability to Constrain** The sultan’s military and political position seems to have been an important determinant of the extent to which a head judge could rule against the sultan without being dismissed. While surviving records on judicial proceedings during the pre-Ottoman period are rare, the few that do exist show that decisions made against the sultan and the military only seems to have occurred during periods of regime consolidation or in the face of unusually influential judges (Nielsen (1985), pp. 131-132).

As previously noted, the head judge’s main bargaining chip derived from his influence with the populace. A head judge could refuse to help the leader collect taxes or refuse to legitimate his rule by not pronouncing his name in the Friday prayer. Judges could issue legal judicial opinions (fatwas) authorizing rebellion (Lapidus

(1984), pp. 152-153).<sup>15</sup> In addition, without the help of the legal scholars, it appears to have been difficult for the populace to coordinate and create coherent pressures on the state (Lapidus (1984), p. 153). To the extent that this was the case, the jurists also held the key to popular uprisings.

Despite their ability to influence the populace, when the sultan was in a strong military and political position, the ability of the judge to constrain the actions of the political ruler seems to have been at best variable. Judges that went against the ruler's demands were at times sacked and replaced with more agreeable candidates.

In sum, Muslim law and its representatives appear to have acted at times as a check on the actions of political leaders. Their influence, however, seems to have varied according to the relative strength of the ruling elites. Many times –when the leader felt strong enough– he would simply ignore the prohibitions of the legal scholars, dismiss the head judge<sup>16</sup> and pursue whatever course of action he desired in the interim. In times when he felt less secure, he would cave to the religious elites' demands and refrain from his desired action.

## **2 The Effect of Nile Failures on Political Outcomes: Historical Evidence**

The previous discussion suggests that shocks that weaken the political authority should, all else equal, strengthen the bargaining power of the judiciary. This section provides historical evidence that this was the case.

The section begins by detailing the economic effects of abnormal Nile floods and then investigates the political effects of these floods.

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<sup>15</sup>Tyan (1960) p. 116, 424.

<sup>16</sup>The historiography suggests that if a Sultan desired to go against the wishes of the head judge he would dismiss the judge (Tyan (1960), Nielsen (1985), p. 3).

## 2.1 Economic Effects

The dependence of the pre-modern Egyptian economy on the annual Nile flood is well known. Countless sources corroborate the key role the flood played in determining pre-modern Egypt’s agricultural and thus economic prosperity.

When the Nile flood greatly deviated from the optimal flood level, historical sources recount armageddon-like conditions. The historian Ibn Iyas reports the conditions following one deficient Nile flood:

[i]n the year 451 h. (1059 CE), there was a famine such as Egypt has never seen [...] the Nile reached 12 cubits and then would drop [...] wheat reached the price of 100 dinars per ardeb [about 70 kilograms] and eventually it was impossible to find. Men ate cadavers, cats and dogs.<sup>17</sup>

The extreme dependence of pre-modern Egyptian agricultural production on the Nile flood derived from the fact that without a “sufficient” Nile flood much of the land normally used for agricultural production became barren. Floods that were too “high” or were also associated with severe economic downturns.<sup>18</sup>

## 2.2 Political Effects of Nile Failure

Pre-Ottoman Egypt appears to neatly fit what North, Wallis and Weingast (2009) have dubbed a “natural” state. In their framework, natural states contain violence through the “formation of a dominant coalition whose members possess special privileges” (p. 18). Transfer payment keep the coalition together, and in their framework “unexpected shocks [...] can destabilize the internal relationships within the dominant coalition” (p. 21).

Consistent with North et al.’s framework, transfer payments appear to have held together the ruling military coalition in pre-Ottoman Egypt. A large part of the payments to coalition members were made in grain (Lapidus (1969, p. 12). Given

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<sup>17</sup>Cited by Toussoun (1925), p. 457.

<sup>18</sup>Popper (1951), p. 79.

that sultans purchased the loyalty of many of their followers it is not surprising that “[m]ost [...] mutinies and disturbances were caused by the cancellation, postponement or curtailment of pay” (Ayalon (1958), p. 287).

Nile failures appear to have destabilized the military coalition through 2 channels:

1) Nile failures temporarily decreased the agricultural resources available to the Sultan, decreasing his ability to pay the military coalition. This temporary decrease in revenue opened a window for rivals to form coalitions and to revolt.

2) Nile failures pushed significant members of Egypt’s population below subsistence. By lowering the opportunity cost of revolt, Nile failures created bodies of roaming “bread rioters” (Shoshan (1980), p. 471, 473). While these rioters concentrated on attacking bakeries and mills, they also stoned government officials. At times the sultans themselves were the target of the Nile-induced anger of the populace (Shoshan (1980), p. 471).

Nile failures put pressure on the sultan by reducing his ability to pay the military and by encouraging disturbances. The religious elites stood to gain from these pressures since it was difficult for the rebellious population to coordinate their actions without help from the religious authorities (Lewis (1953), Lapidus (1984), p. 153). A prominent historian of the period sums up the political effects of grain shortages by noting that “[e]very grain crisis thus became a political game raging around the Sultan” (Lapidus (1984), p. 147).

### **2.2.1 Rebellions, the Religious Authorities and Popular Support**

Failed Niles often led rival military officers to rise in open rebellion (Garcin (1998), p. 292). In the ensuing civil wars, the support of the populace could determine the war’s outcome.

Thus in these wars “each of the contesting parties tried to enlist the support of the commoners” (Perho (2001), p. 117) and on at least one occasion both the Sultan and his rival tried to gain popular support by offering payments to the populace who fought with stones and slings (Perho (2001), p. 117, 118).

If Muslim clerics held the key to popular support and coordination, one would

expect their bargaining position to improve vis-a-vis the political authority following Nile-induced economic shocks. One scholar has summed up the process that led to this increased influence by noting that with the onset of “civil wars, the support of the ulama (legal scholars), and with it massive popular backing, was often of decisive importance. Rebels and pretenders vied for recognition of the legitimacy of their claims, and sought fatwas or judicial opinions justifying rebellion. In addition, the ulama [clerics] could offer even more direct help by accepting public offices under rebel emirs” (Lapidus (1984), p. 134).

In sum, the historical evidence suggests that political leaders had increased incentives to cater to religious elites during periods of economic distress. These increased incentives derive from the fact that economic crises divided the military coalition making popular support significantly more important than it was during times when the coalition remained firm. In addition, Nile shocks drove part of the population to riot which made keeping the legal community on the ruler’s side increasingly important since without the support of this legal community coordinating these riots across locations was difficult.

### **3 The Data, Nile Exogeneity and Timing of the “Treatment”**

The historical record suggests that religious authorities gained bargaining power during periods of Nile-induced economic downturn. The remainder of the paper investigates this claim empirically. This section explains the data sources, section 4 presents the bulk of the empirical evidence and section 5 provides further empirical and historical evidence to weigh competing explanations.

## 3.1 The Data

### 3.1.1 Nile Flood Data

Medieval Muslim historians recorded data on the Nile’s flood and minimum level. These historians appear to have copied records compiled by the guardians of the Rauda nilometer (Popper (1951), p. 91) and have left us with 2 copies of the Nile flood records spanning over 700 years. Ibn Taghrī Birdī provides statistics for the period covering 641-1467 CE (20-871 Hijri) in his chronicle *al-Nujūm al-Zāhira fī Mulūk Miṣr wa al-Qāhira* (The Sparkling Stars among the Kings of Egypt and Cairo). Ibn al-Ḥijāzi provides the second set of statistics covering the period 622-1470 CE (1-874 H) in his *Naʾil al-Rāʾid min an-Nīl az-Zāʾid* (Obtaining Sustenance from the Increased Nile ).

The original data give the minimum and maximum levels of the Nile flood in cubits and fingers. These data are not strictly comparable across years since they suffer from problems related to a change in the height of the base of nilometer, as well as a lack of uniformity in the divisions of the cubit and the length of the cubit (Popper 1951). Popper (1951) provides a mapping from cubits into meters above sea-level for the period covered by the data used in the analysis.

The two Nile time series used in the paper are taken from the original sources.<sup>19</sup> Ḥijāzi’s data exists in manuscript in the *Bibliothèque National de France* and were transcribed by the author. Taghrī Birdī’s data was transcribed by Bāshā (1916) and is also available in published versions of Taghrī’s chronicle. The data sets appear to be independent copies of different Nile statistics.<sup>20</sup> This fact makes assumptions of measurement error independence made below plausible.

The recorded maximums of the Nile flood as recorded by Ḥijāzi and Taghrī Birdī

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<sup>19</sup>The Nile data set used in the scientific literature are taken from Toussoun (1925) and were graciously shared by Alexander Ruzmaikin. These data, however, are an ad hoc amalgam of Hijazi’s and Taghri’s data and use the wrong scale to convert cubits to meters above sea level (Popper (1951) ). Not surprisingly, results using this data set are severely attenuated although qualitatively similar to the results presented below.

<sup>20</sup>See Popper (1951, p. 156) for a discussion.

are detailed in figure 1. The horizontal line marks the “plenitude” level (16 cubits) which was originally considered the most favorable level for the irrigation of Egypt. The first panel in table 1 provides summary statistics for the Nile data.

Examination of the data show that the Nile appears to have slowly trended upwards as time progressed. This was due to the rise of the Nile bed due to sediment accumulation (Popper (1951)). In addition, while the two times series closely track one another there are non-trivial divergences between the two (including the number of observations). These divergence stem from scribal error and confusion in the occurrence of “skip years” (Popper (1951)). These skip years are due to the backwards cycling of the Hijri (lunar) years through the solar years. Further discussion of the sources of error are provided in the appendix, as are estimates of the attenuation bias.

Aside from these issues the general quality of the Nile data is generally recognized and have widely been used to investigate climatic variations.<sup>21</sup>

### 3.1.2 Rulers and Head Judges

The month and year of changes in the political authorities were collected from a variety of sources by Amīn Sāmī Bāshā (1916). The month and year of changes in the office of head judge come from Ibn Ḥajar’s (1998 [1449]) *Raf’u al-Iṣr ’an Quḍāt Miṣr* (The Lifting of Difficulties Surrounding Egypt’s Judges). This book details the biographies of Egypt’s head judges from the Muslim conquest (640) through 843 hijrī (1438 CE). The book was written by Ibn Ḥajar (773-852 h) who was requested to provide biographies of the judges named in a poem (*rajaz*) written for the head judge *Badr al-Dīn*. The biographies are thought to be reliable with the exception of those for the earliest judges (Escovitz 1984, p. 5).

The judges are presented alphabetically and although appointment and dismissal years are available for most of the judges, they are missing for a few. To fill in the chronological blanks, I used the original poem which organized the judges in

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<sup>21</sup>See Ruzmaikin et al. (2006) and the references therein.

chronological order<sup>22</sup> to impute the few missing dismissal and appointment dates. The few cases in which the dismissal year could not be determined with a high degree of certainty were left blank. There were also a few brief periods in which there was not an appointed head judge.<sup>23</sup>

Much of the empirical analysis uses the hijri year as the unit of observation and a dummy variable indicating whether there was at least one change in the judiciary/sultanate during that year as the dependent variable. Summary statistics for these dummy variables are presented in table 1 and show that each hijri year there was roughly a 20% probability of a change in the sultanate and judiciary.

### **3.2 Nile Flood Exogeneity: Determinants of the Annual Flood**

Flood variations in the Nile as it passes through Egypt are primarily determined by changes in the White and Blue Nile, which are driven, in turn, by rainfall in equatorial Africa and Ethiopia. The White Nile begins in equatorial Africa, while the source of the Blue Nile is located in Ethiopia.<sup>24</sup>

During most of the year, the Nile is primarily fed by the White Nile. During this period the Blue Nile only contributes a quarter of the Nile's volume. The yearly Nile summer flood, however, is primarily driven by the Ethiopian monsoon season through a surge in the Blue Nile. The monsoons that cause the Nile floods are associated with the northward shift of the intertropical convergence zone (ITCZ) while the Nile minima originate in tropical East Africa.

Since Nile variation is driven by rainfall thousands of miles south of Egypt, and variation in Egyptian rainfall is small (since most of Egypt is desert), it seems likely that Nile variations only affected Egypt through directly Nile-induced phenomenon

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<sup>22</sup>This poem can be found in Ibn Ḥajar (1998) pp. 4-21.

<sup>23</sup>When there was more than one head judge (briefly under the Fatimids and under Mamluks after (1265)), I chose to include the data of the shafi'i judge (since the shafi'i school was the most popular and influential in Egypt during the Mamluk era). In addition, months of dismissal are available for over 80% of the judges.

<sup>24</sup>The following section draws on Hassan (2007) .

(and not other climatological phenomenon in Egypt that were correlated with Nile floods). This fact, combined with recent research linking Nile flood variation to sunspots (Ruzmaikin, Feynman and Yung (2006)), provides grounds to believe that Nile flood variation is exogenous.

### 3.3 Timing of the Flood “Treatment”

Historical records suggest that the populace began to suspect a Nile “failure” based on the summer rate of rise of the Nile. The rise appears to have begun around mid-July (Shoshan (1980), p. 69). Scientific studies have confirmed this timing by detailing that around mid-July the Ethiopian monsoon waters began to reach Egypt. By the middle of August the inundation reached its peak. By May, the Nile sank to its lowest level.

Egyptian political leaders appear to have been well aware of the possibility of forecasting the next year’s crop based on the rate of increase in the Nile during the summer months. Indeed, the Nile flood data appear to have been originally copied from government records of the Nile’s flood compiled by the guardian of the Nilometer (Popper (1951)). Given the previously discussed political effects of Nile failures it is not surprising that sultans tried to keep the rate of increase of the Nile during the summer a secret.<sup>25</sup>

Given the devastating effects a failed Nile could have on the population, abnormal rises in the Nile during the summer months aroused anxiety among the populace (Shoshan (1980), p. 469). Maqrizi, a 15<sup>th</sup> century Egyptian historian, documents one year’s reaction to indications that the Nile had stopped rising as follows:

“[t]he Nile stop increasing for several days. Grain prices rose and merchants stopped selling it. People’s worry increased. They were called upon to stop committing what Allah forbade, and instead to commit themselves to virtue [...] Many people fasted the next day, including the sultan”<sup>26</sup>

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<sup>25</sup>Philipp and Haarmann (1998), p. 259.

<sup>26</sup>Philipp and Haarmann (1998), p. 274

Since an abnormal rate of Nile increase in the summer implied a smaller harvest, a sizeable amount of the economic effects of a Nile failure (e.g. substantially higher grain prices) appears to have been priced in to the Egyptian grain market starting in the middle of the summer.<sup>27</sup> Once a Nile failure became common knowledge, there is evidence that a sultan’s rivals began to coordinate amongst each other.<sup>28</sup> By September at the latest Egyptians observed the Nile’s maximum level and could forecast the next year’s crop with a reasonable degree of accuracy.

To summarize, it seems that around mid-July the effects of a Nile failure would begin to appear. The populace would know of a Nile-failure at the latest by September.

## 4 The Effect of Nile Failures on Political Outcomes: Empirical Evidence

The historical record suggests that to the extent that the Egyptian head judge held the key to popular support, he should have had increased bargaining power vis-à-vis the political authorities during times of Nile failure.

While we don’t observe the judge’s bargaining power, we do observe whether or not he was dismissed. This seems a plausible measure of his influence (*ceteris paribus*) since judicial tenure has been linked to increased judicial independence (La Porta et al. (2004)). In addition, the historiography suggests that if a sultan desired to go against the wishes of the head judge he would dismiss the judge (Tyan (1960)),

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<sup>27</sup>For evidence that suppliers attempted to hoard grain upon news of an adverse crop the following year see (). Maqrizi (a prominent historian who lived in the 14th and 15th centuries) recorded that “an insufficient level of the Nile [... caused] prices to r[i]se sharply [... and] the populace [to live] in a heightened state of fear” (Ighatha, 31).

<sup>28</sup>This is due to the fact that these military members would realize that they would get lower payments when the next crop was harvested. For evidence that the military had already been paid from the previous year’s crop before the Nile flood (and that the Sultan’s year-to-year budget constraint was binding (so that it was difficult for him to stockpile enough produce to prevent rebellions in “bad years”) ) see (Ayalon).

Nielsen (1985), p. 3).

Since we also observe whether a given political was deposed, if we had an error-free measure of Nile variation, knew the functional form of the relationship between political outcomes and Nile floods estimating the effects of Nile failure on political outcomes would be straightforward.<sup>29</sup>

Unfortunately, the Nile flood data appear to be measured with substantial error (see appendix). Moreover, we don't know the functional form of the relationship although the literature suggests that economic output should decrease as the Nile deviates from its "goldilocks" level. For most of the empirical analysis we will treat high and low deviations from the "goldilocks" level as symmetric.<sup>30</sup>

We will begin by considering the linear probability model of the form

$$y_{idt} = \alpha_d + \beta z_t^2 + \varepsilon_{idt} \quad (1)$$

where  $y_{idt}$  is a dummy variable equal to one if at least one political (religious) leader  $i$ , in dynasty  $d$  changed in hijri (lunar) year  $t$ . The variable  $z_t^2 \equiv (Nile_t - \widehat{Nile}_t)^2$  is the squared deviation of the Nile flood that occurred in Hijri year  $t$  from some long-term average  $\widehat{Nile}_t$  (we use the deviation from a linear time trend, see appendix for details).<sup>31</sup>

The linear probability model seems a natural starting place in our context due to the significant complications introduced by a non-linear function of a non-linear function of measurement error.<sup>32</sup> Reassuringly results using probit and standard duration models yield qualitatively similar results.<sup>33</sup>

Figure 2 details the non-parametric (locally weighted regression) relationship between the two "change" dummies and the mean of the deviation of the two Nile

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<sup>29</sup>Ideally, in addition, we would possess a measure of GDP.

<sup>30</sup>Empirical investigation of this symmetry does not allow us to reject the hypothesis that abnormally low flood have the same effect as abnormally high floods.

<sup>31</sup>While we could also consider the absolute deviation, this makes the measurement error much more complicated.

<sup>32</sup>See Amemiya (1985), Hausman et al. (1991, 1995).

<sup>33</sup>Duration results are presented in section (4.4.2). Probit output is available from the author upon request.

sources.<sup>34</sup> The U-shaped relationships are striking, consistent with the hypothesis and suggest that using  $z_t^2$  as the independent variable provides a decent approximation to the relationship of interest.

## 4.1 Estimates by Hijri Year

The results of equation (1) for sultans are reported in table 2. The first panel presents OLS results using Hijazi’s and Taghri Birdi’s data. Columns (1) and (2) present the results using the entire time series (823 hijri years) without dynasty dummies. Columns (3) and (4) add dynasty dummies and columns (5) and (6) drop observations before Egypt became fully independent of the Abbasid Empire.<sup>35</sup> The point estimates suggest that the sultanate was more likely to change hands in years of flood, although most of these estimates are not significant at conventional levels. This is not surprising given the evidence that the flood data is measured with significant error (see appendix for a discussion).

Panel 2 in table 2 details point estimates obtained using Hausman et al.’s (1991, 1995) algorithm for consistently estimating polynomials of a variable measure with error.<sup>36</sup> The results presented use Hijazi’s data to calculate higher order moments (i.e. Hijazi’s data is elevated to powers greater than one).<sup>37</sup> Although at best marginally statistically significant, the point estimates using Hausman et al.’s framework are between 7 and 20 times larger than those obtained using OLS (consistent with the theoretical framework).

Panel 3 presents the results instrumenting one squared Nile deviation with the other. These point estimates are consistent under plausible assumptions on the errors. Assumptions and proofs are detailed in the appendix. The first two rows

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<sup>34</sup>The general shape of the relationship does not change if we only use one of the Nile time series.

<sup>35</sup>Egypt was also independent to varying degrees under the Tulunid and Ikhsidid dynasties.

<sup>36</sup>Standard errors are bootstrapped using the parametric bootstrap and 400 replications. This was done mainly for computational ease. The one group of standard errors I calculated using Hausman et al.’s algorithm were quite close to those using the bootstrap.

<sup>37</sup>Estimates calculated raising Taghri’s data to powers greater than one render the standard errors uninformatively large. This suggests that measurement error is leptokurtic in Taghri’s data .

detail the IV estimates. The last two rows detail the first stage and demonstrate that the instruments are not “weak”. Tests for the equivalence of the instrumented coefficients were done using the non-parametric bootstrap with 400 replications and do not reject the hypothesis that the two sets of estimates are equal.

These results suggest that a one meter deviation of the Nile from its long-term trend (roughly 2 standard deviations) made a change in the sultanate that year between 13 and 30 percentage points more likely. This is a sizeable effect (recall that the yearly probability of dismissal was roughly 20%).

Table 3 details the results for judge dismissal. Since these are reported in an identical manner to those in table 2, we will simply note that in general a one meter deviation in the Nile made a judge change that year 8 to 30 percentage points less likely.

To summarize, the results by hijri year suggest that the sultanate was more likely to change hands during periods of large Nile deviations. The judiciary, seems to have been less likely to change hands during periods of large deviations.

## 4.2 Estimates by Hijri Month

The previous analysis using the Hijri year as a unit of observation ignores the fact that a flood in a given Hijri year “treated” that hijri year for an amount of time that varied depending on in what year the flood occurred. Although this omission should not bias the previous results<sup>38</sup>, using the hijri year as a unit of observation discards potentially valuable information.

We know the hijri month that the political leadership changed hands and the month of many of the judge changes.<sup>39</sup> Equipped with the transition month we can further investigate the effect of Nile failure on political outcomes since even within a given Hijri year some months are “treated” with that hijri year’s flood while others

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<sup>38</sup>Reassuringly, including the number of months remaining in the hijri year after July 15th does not significantly change the point estimates or the qualitative implications of the results.

<sup>39</sup>For judges missing month changes are set to 0 (results are similar if we instead code them as missing). For the 254 judges changes detailed in the data, 218 (86%) detail the month of dismissal.

are “treated” with the previous hijri year’s flood.

For ease of exposition we continue to use the hijri year as the unit of observation.<sup>40</sup> We then calculate the variable  $elapsed_{mt} = month_{mt} - floodmonth_t$  where  $floodmonth_t$  (ranging from 1-12) is the hijri month corresponding to July 15<sup>th</sup> (July 15<sup>th</sup> was chosen since information on the Nile’s flood level began to be revealed in July, see section 3.3)  $month_{mt}$  is the hijri month (ranging from 1-12) and m indexes hijri months and t indexes hijri years. The variable  $elapsed_{mt}$  ranges from -11 to 11.<sup>41</sup> If Nile variation does not cluster, we would expect no effect on judge changes or political changes before the advent of the flood.

The regression used to test this hypothesis is of the form:

$$y_{mt} = \sum_m \beta_{em} elapsed_{mt} + \sum_m \beta_{zm} elapsed_{mt} * z_t^2 + \varepsilon_{mt} \quad (2)$$

where the variables are as previously defined ( $y_{mt}$  is the political change of interest and  $z_t^2$  is the Nile’s deviation). Unless Nile floods are strongly autocorrelated (so that a flood in one year is a good predictor on the next year’s flood), we would expect the coefficients  $\beta_{zm}$  to be close to 0 for m such that  $elapsed_{mt} < 0$  (i.e. in the months before the advent of this year’s flood we wouldn’t expect this year’s flood to be correlated with outcomes unless last year’s flood is correlated with this year’s flood).

Summations of the  $\beta_{zm}$  (estimated by instrumenting  $elapsed_{mt} * taghri_t^2$  with  $elapsed_{mt} * hijazi_t^2$  where  $taghri_t^2$  are Nile deviations calculated using Taghri’s data and  $hijazi_t^2$  are calculated using Hijazi’s data) are presented in figure 3 for both judges and sultans.

The upper right-hand graph detail  $\sum_{m < 0} \beta_{zm}$  (standard errors are calculated using the method detailed in Salinger (1992)) and the upper left-hand graph  $\sum_{m \geq 0} \beta_{zm}$  for

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<sup>40</sup>Alternatively, one could define as the unit of observation the “Nile Year” from mid-July to mid-July. The results do not qualitatively change using this unit of observation but I decided against defining yet another year in the interest of clarity.

<sup>41</sup>We assign skip years a floodmonth of 1 (since the whole year was treated by the previous year’s flood and we have assigned skip years this previous flood).

sultans. Interestingly, the effects of Nile failure do not seem to register in a change in the sultanate until around January (or 6 months after July 15<sup>th</sup>). This is a sensible result, since one would expect a rival to take time to form a rival coalition and to dethrone the incumbent. Reassuringly, there is little evidence of effects of deviant Nile floods before they occurred.

The lower two graphs in figure 3 detail the same quantities for judges. The decline in the probability of judge dismissal is again concentrated after the Nile flood.<sup>42</sup>

Regressions using monthly data and variation in the percentage of the lunar year “treated” caused by the Muslim lunar calendar provide further evidence that Nile failures made a change in the sultanate more likely yet made one the judiciary less so.

### 4.3 Length of Effect: Distributed Lag

The analysis has thus far examined the “instantaneous” effect (or impact multiplier) of Nile failure on the outcomes of interest. It may be the case, however, that Nile famines take time to have an effect (and inasmuch as Nile failures are correlated across time the estimated “impact” coefficients may also be picking up the effects of past floods). To investigate the effect long-term effect of Nile deviations on a given outcome we estimate a distributed lag specification of the form

$$y_t = \alpha + \sum_{i=0}^p \beta_i z_{t-i}^2 + \gamma X + \varepsilon_t \quad (3)$$

Maximum  $p$  was set to 5 and the Schwartz criteria suggested using all 5 lags.<sup>43</sup> Equation (3) is estimated both using Hijazi’s data (since his data is measured with less error) and instrumenting Taghri Birdi’s data with Hijazi’s (since this produces

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<sup>42</sup>Although not overwhelming, there is some evidence that this downward trend held the whole year. This may be due to Nile autocorrelation and the long-lived effects of Nile deviations on the judiciary (see section 4.3). It should be stressed, however, that the lion’s share of the effect obtained after July 15<sup>th</sup>.

<sup>43</sup>Maximum  $p$  was set to five because this was roughly the average length of a judge’s tenure. Longer lag structures yield qualitatively similar results.

tighter confidence intervals).<sup>44</sup> The results are presented in table 5. The first panel details the OLS results and the second panel details those obtained using instrumental variables. Results are presented for both before and after Egyptian “independence.”

In general, the results suggest that while the effect of a deviant Nile on the sultanate was short lived, the judiciary was affected for a longer period.

## 4.4 Alternative Specifications

### 4.4.1 Extreme Values

We have thus far concentrated on continuous measures of Nile deviations since this allows us to obtain consistent estimates of the parameters of interest. Alternatively, we could examine extreme values of Nile deviations (such as the 90% or 95% percentile cutoff). Results using these cutoffs are generally statistically significant. In the interest of parsimony, these results are not provided. The results do suggest, however, that only relatively large Nile deviations were likely to have sizeable effects on political outcomes.

### 4.4.2 Hazards and Durations

In some ways, the data are more suited to analysis with standard duration models. Given the qualitative similarity of the results to those presented and the difficulties associated with measurement-error in non-linear models, we will only briefly consider these results.

We fit a Cox proportional hazard model with varying coefficients, assigning for each hijri year and judge a censoring indicator equal to 0 if the judge was not released that year and equal to 1 if he was (see Cameron and Trivedi (2005), p. 599 for details).

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<sup>44</sup>Unbiasedness of the IV estimates is not a problem if the  $z_{t-i}^2$  are not serially autocorrelated. If this is the case, then the previous proofs of attenuation bias and IV consistency hold for each individual  $\beta_i$ . If the  $z_{t-i}^2$  are autocorrelated, matters become slightly more involved although under a few assumptions IV remains consistent. See appendix for details.

We use the mean of the two sets of Nile data.<sup>45</sup>

Results suggest that a judge in power in a year with a one meter deviation in the Nile flood has 0.74 the probability of being dismissed than if there had not been a flood. Results for sultans suggest a one meter deviation in the Nile flood made his release 1.24 that of what it would had been had the Nile flooded according to its long-term average.

The results also suggest that the judge effect lasted roughly 4 years, while the effect on the sultan was concentrated in the flood year.

## 5 Possible Explanations

The empirical results presented thus far suggest that Nile failure made the sultanate more likely to change hands, while the judiciary was less likely to alternative during periods of Nile-induced economic distress. Although this result is consistent with the historical evidence presented in section 2 suggesting that religious elites gained bargaining power during periods of Nile-induced economic distress, it is also consistent with other explanations.

This section further investigates the empirical evidence and uses the results in conjunction with the historical record to weigh the plausibility of a variety of causal channels that are consistent with the observed statistical patterns.

### 5.1 “Hunkering Down” During Famines

Perhaps the most threatening alternative explanation involves the “hunkering down” of political leaders during times of economic distress. Under this explanation, the leader observes a deviant Nile and refrains from dismissing any officials. This would be a product, perhaps, of his preoccupation with Nile-induced problems.

The results presented in section 4.3 provide some evidence against this hypothesis. If judges were less likely to be dismissed during years of deviant Niles simply due to

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<sup>45</sup>This strategy yields consistent estimates as the number of Nile observation becomes large, see Amemiya (1985) and Cameron and Trivedi (2005, p. 913) for details.

political inertia in times of crisis, one would expect this result to disappear after the shock ended. The data, however, suggest that this was not the case.

Further analysis of the patterns of change in the sultanate and judiciary provides additional evidence against this hypothesis. In this section, claims of causality are much more tenuous since although Nile floods are arguably exogenous, outcomes are not. In other words, leaders who respond in one way to the flood are probably different on a host of unobservables from those who respond in another. Despite this drawback, the observed patterns point towards increased political influence by the judiciary and away from alternative explanations.

### 5.1.1 The Sultanate

To better understand the empirical strategy, consider hypothetical outcomes for each Hijri year for sultans. Let  $S_t(shock, judge)$  denote the hypothetical outcome of the sultanate in year  $t$  (change or no change) for different values of Nile shocks or judge changes.<sup>46</sup> For example,  $S_t(1, 1)$  represents the Sultan's outcome in year  $t$  (change in the Sultanate or not) if there was a Nile shock and there was a change in the judiciary.

Suppose we made the following comparison  $E[S_t|shock_t = 1, judge_t = 1] - E[S_t|shock_t = 1, judge_t = 0] = E[S_t(1, 1) - S_t(1, 0)|shock_t = 1, judge_t = 1] + E[S_t(1, 0)|shock_t = 1, judge_t = 1] - E[S_t(1, 0)|shock_t = 1, judge_t = 0]$ . And the comparison is equal to the causal effect of judge dismissal on the stability of the sultanate during Nile failure (among the population that dismissed the judges) plus the bias term  $\xi \equiv E[S_t(1, 0)|shock_t = 1, judge_t = 1] - E[S_t(1, 0)|shock_t = 1, judge_t = 0]$  which represents the fact that those Sultans who had judge dismissals during years of Nile failure may have been different on unobservables from those that did not (for example they may have been in a stronger or weaker position). If judge dismissal was not important for a leader's survival in times of Nile failure  $S_t(1, 1) - S_t(1, 0) = 0$

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<sup>46</sup>The use of dummy variables for Nile shocks instead of the continued use of the continuous metric was done in the interest of clarity. The two approaches are clearly related, and the dummy variable approach yields qualitatively similar results to a continuous approach although the coefficients in the continuous approach are often estimated with less precision.

and we would expect  $E[S_t|shock_t = 1, judge_t = 1] - E[S_t|shock_t = 1, judge_t = 0]$  to be small unless  $\xi$  is large.

We would expect  $\xi$  to be large and our story not to hold, for example, if judge changes were generally associated with sultan changes and thus those sultans who had judge dismissals were on average weaker than those who didn't. This story, however, also suggests that  $E[S_t|shock_t = 0, judge_t = 1] - E[S_t|shock_t = 0, judge_t = 0] = [S_t(0, 1) - S_t(0, 0)|shock_t = 0, judge_t = 1] + E[S_t(0, 0)|shock_t = 0, judge_t = 1] - E[S_t(0, 0)|shock_t = 0, judge_t = 0]$  should be greater than 0 (since  $S_t(0, 1) - S_t(0, 0)$  should be zero if judge dismissal had no effect<sup>47</sup> and  $\xi_2 \equiv E[S_t(0, 0)|shock_t = 0, judge_t = 1] - E[S_t(0, 0)|shock_t = 0, judge_t = 0] > 0$ ).

In general, the difference in difference  $E[S_t|shock_t = 1, judge_t = 1] - E[S_t|shock_t = 1, judge_t = 0] - (E[S_t|shock_t = 0, judge_t = 1] - E[S_t|shock_t = 0, judge_t = 0]) = E[S_t(1, 1) - S_t(1, 0)|shock_t = 1, judge_t = 1] - [S_t(0, 1) - S_t(0, 0)|shock_t = 0, judge_t = 1] + \xi - \xi_2$ .

While this difference could differ from zero and there be no effect of judge dismissal on the stability of the sultanate, it would have to be the case that  $\xi - \xi_2$  is relatively large. In other words, it would have to be the case that judge dismissal is an indication of something different about the underlying characteristics of the Sultan in times of Nile failure than it was in times of plenty (and for our story to fail this "something different" can't be related to increased expectations of deposition in times of Nile failure if one deposes the judge) . If  $\xi - \xi_2$  is comparatively small then the difference in difference provides an approximation to the causal difference  $E[S_t(1, 1) - S_t(1, 0)|shock_t = 1, judge_t = 1] - [S_t(0, 1) - S_t(0, 0)|shock_t = 0, judge_t = 1]$ .

These are estimated by a regression of the form

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 shock_t^* + \beta_3 shock_t^* * X_t + \varepsilon_t \quad (4)$$

where  $shock_t$  is a dummy variable equal to one if squared Nile deviation is above

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<sup>47</sup>Since if judge dismissal did not have an effect during crises the historical evidence suggests judge dismissal was even less likely to have an effect during normal periods.

the cutoff from *Hijazi*'s data (we use 90% and 95% cutoffs)  $X_t$  is a dummy for sultan (judge) changes and  $Y_t$  is a dummy for judge (sultan) changes. The use of *Hijazi*'s data to calculate the cutoffs introduces attenuation bias in the coefficients of interest (see appendix for details).

The results are presented in the lower panel of table 4. The results show that the probability the sultanate changed hands in a shock year without a change in the judiciary was roughly 30%. This rose to between 50 and 83% if there was a change in the judiciary.

### 5.1.2 The Judiciary

While these results provide further support to the claim that the judiciary was more influential during economic crises, the possibility remains that the quantity  $\xi - \xi_2$  is large for reasons that have nothing to do with increased bargaining power.

If judges did not have increased bargaining power in times of Nile failure, but simply were left in power for stability's sake (or became increasingly sycophantic), we would expect the incoming Sultan to also be more likely to leave the head judge in power when the Sultanate changed hands in years of Nile failure than when it changed hands in normal years.<sup>48</sup> The results reported in the upper panel of table 4 do not confirm this hypothesis.

Indeed, we can not reject the hypothesis that incoming sultans in years of Nile failure were just as likely to depose the existing judge as incoming sultans in years of plenty. This provides further evidence that the observed dismissal patterns in were not simply driven by government "hunkering down."

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<sup>48</sup>There may have been incentives to place one's friends in lucrative positions to secure allegiance in which case the new Sultan would have an incentive to change the existing hierarchy. The previous Sultan, however, also had similar incentives to make changes in order placate rebels and/or quell rebellions.

## 5.2 Increased Sultan Superstition

Another alternative hypothesis that is consistent with the results involves an increase in “superstition” on the part of the ruler or a belief that Nile failure was a divine punishment for some misdeed.

The chroniclers, at the very least, seem to have thought this a determinant of the sultan’s more respectful behavior towards religious authorities during crises. During one severe plague the sultan

“asked the four chief qadis [judges] and some other faqihs [legal scholars] whether the plague was God’s punishment for some sins the people had committed. The legal scholars said that God might punish fornication by sending a plague and some of them held the opinion that the sin could be avoided if women were forbidden to come out of their houses. The Sultan agreed and announced that the women would be severely punished if they did not obey the decree”<sup>49</sup>

This explanation is plausible, consistent with the observed patterns and can’t be ruled out with the available data.

## 5.3 Increased Sultan Mortality

Given that sizeable sections of the population died during large Nile deviations, one might worry that Nile failures would affect the health of the judge or sultan. While this would bias the judge coefficient toward 0 (since this coefficient is less than zero), it would bias the sultan coefficient upwards. While this is a possibility, the sultan was likely the last person in society likely to be hit by starvation. Sultan exposure to famine-induced epidemics is a more plausible possibility although the fact that the judge coefficient is negative suggests this is probably not a first-order concern.

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<sup>49</sup>Perho (2001), p. 115.

## 5.4 Increased Ulama Bargaining Power

When taken in unison the evidence points towards interpreting the results as indicative of increased bargaining power by the head judge. Whether this increased bargaining power was due to increased superstition on the part of the political leader or an increased need for the judge's influence with the population is impossible to determine with the available data. The length of the effect, however, suggests that the judge used his temporary increase in bargaining power to cement his power base.<sup>50</sup>

Aside from increasing his tenure in office, the data do not allow us to empirically investigate what the head judge did with his increased bargaining power following deviant Niles. Qualitative evidence, however, suggests that these leaders may have pressured the political leaders to more closely implement Muslim law.

A prominent historian has summed the evidence to conclude:

“when God’s displeasure had been manifested in the form of pestilence or drought, the sultan would bow to ‘ulama’ [...] pressure and enforce decrees against [...] prostitution, hashish eating, beer drinking, the wearing of immodest or over-luxurious dress [and] Christian and Jewish functionaries lording it over Muslims.”<sup>51</sup>

## 6 Conclusion

This paper has examined how Nile-induced economic shocks affected the balance of power between “church” and “state” in pre-modern Islamic Egypt. The results suggest these economic shocks strengthened the bargaining position of the “church”.

Although the data do not allow us to pin down the exact causal mechanisms that led to this increased political influence, the historical record suggests that this increased influence was in part a product of the religious elite’s influence with the local population. In this sense, the results provide support for claims by prominent

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<sup>50</sup>For the link between judicial tenure and increased political influence in Muslim societies see []

<sup>51</sup>Irwin (1986), p. 50.

historians that in pre-modern Islam “religion provided the only possible expression, in public and social terms, of sustained opposition” (Lewis 1953).

More broadly, the results suggest that examining how societies coordinate to resist the status quo may shed light on how a society’s institutional framework changes. Recent research has shown that institutional changes are more likely to occur during periods of economic distress. The research up until now, however, has ignored what determines who gains from economic crises. Understanding who gains in a crisis seems to be an important part of understanding how a society’s institutional framework evolves.

In this sense, the results relate to a growing literature suggesting that the relationship between “church” and “state” in Islam explains part of the long-term institutional and economic stagnation in predominantly Muslim countries. Although the results in this paper provide empirical evidence of an increase in the dependence of political authorities on religious elites during periods of economic crises, the results show that its intensity varied according to the power of the political authority.

The results, then, suggest caution when attributing various outcomes to the influence of these religious elites. It seems that the ability of the “clergy” to impose their will was, to a certain extent, endogenous – a reflection of the state’s health. This health -in turn- may have been due to the political influence of the ulama or to other factors.

Finally, the results may speak to the political dynamics in some Muslim societies today. A recent overview of politics in Muslim-majority countries shows that in many countries Muslim clerics retain much of their medieval role as go-between between the political authority and the populace.<sup>52</sup> In many regions -today as in the past- this translates into substantial political influence.<sup>53</sup> If history is any guide, the results in this paper suggest implementing reforms that threaten the interests of the religious elites will be easier during periods of economic prosperity.

The political actions of the Muslim “clergy” appears to have helped constrain over-reaching political authority and represent many popular interests for centuries.

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<sup>52</sup>Eickeleman and Piscatori (2004), p. 59

<sup>53</sup>Niblock (2006), p. 15.

Like any “interest” group, however, these religious elites had objective functions that may or may not have been conducive to a variety of economic-enhancing institutional changes.

Although a growing body of research suggests that religious elites played a role in determining institutional outcomes, the determinants of a given religion’s societal influence remain poorly understood. This paper contributes to this literature by demonstrating that, in the Muslim world at least, economic crises seem to have strengthened the political position of religious elites.

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## 7 Appendix

### 7.1 Hijri and Solar Years, Silting and Measurement Error

The Nile flood levels are measured with error in both sources (Popper (1951)). Taghri Birdi and Hijazi appear to have made transcription errors of the original Nile data<sup>54</sup> and also to have been confused by the occurrence of “skip years.” Since the Islamic calendar is lunar and consists of 354 days, a given Hijri day and month cycles backwards through the solar calendar.<sup>55</sup> If we consider a fixed solar date roughly every 33 solar years the hijri year would not contain that solar date. Since Taghri Birdi and Hijazi report the Nile flood in each Hijri year, we would expect a blank or “skip” year roughly every 33 solar years. Since the exact date of Nile flood was stochastic, however, the “skip” year might come sooner or later than these 33 years (to calculate the exact skip years we would need the month and day of the flood in each year which are not provided). Although Taghri Birdi and Hijazi do provide “skip” years, both authors seem to have been confused by these “skip” years.<sup>56</sup>

For the purposes of the empirical analysis, we assign hijri “skip” years the flood data from the previous hijri year (since the entire “skip” hijri year received the “treatment” of that flood). Since the intersection of our data sources span the period 20-843h (640-1438 CE), we have 823 hijri years (798 solar years) of complete data.

As time progressed it appears that the bottom of the Nilometer slowly silted up “inflating” the measured height (put the stuff from popper in here saying that everything rose in tandem). For this reason, we define the deviation of the Nile from its long-term average as the square of the residual from the regression<sup>57</sup>:

$$Nile_t = \alpha + \beta t + \varepsilon_t \tag{5}$$

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<sup>54</sup>Popper (1951), p. 152.

<sup>55</sup>See Popper (1951) p. 123 and the following discussion.

<sup>56</sup>See Popper (1951) p. 123 and the following discussion.

<sup>57</sup>I also experimented adding higher-order polynomials in time. These did not qualitatively alter the results.

the coefficient  $\beta$  is estimated using Taghri Birdi's data to be (time is measured in Hijri centuries) 0.105 with a standard error of (0.008) and using Hijazi's data is 0.107 (0.008) (i.e. the Nile bed rose by approximately 10cm every hijri century due to silting). These nearly identical coefficients are what we would expect if Nile measurement errors are "classical" and suggest that we are able to measure the long-term "goldilocks" flood level with a reasonable degree of accuracy.

The true deviation of the Nile height from its long-term average in year  $t$   $z_t \equiv Nile_t - \widehat{Nile}_t$  is measured both by Taghri Birdi and Hijazi with error. Denote Hijazi's measurements by  $w_t = z_t + \nu_t$  and Taghri Birdi's measurements by  $x_t = z_t + \eta_t$ . Denote the "change" variable of interest (judges or political leaders) by  $y_t$ . Throughout the following we assume (unless otherwise stated) that  $z_t, \eta_t, \varepsilon_t$  and  $\nu_t$  are mutually independent and have mean 0.<sup>58</sup>

Since we are interested in the coefficient  $\beta$  in the regression (ignoring covariates)

$$y_t = \alpha + \beta(z_t)^2 + \varepsilon_t \tag{6}$$

it can be shown that using the measurement  $w_t$  in place of  $z_t$  to estimate  $\beta$  will give  $\hat{\beta} \xrightarrow{p} \beta \frac{\sigma_{z^2}^2}{\sigma_{z^2}^2 + \sigma_{\nu^2}^2 + 4\sigma_z^2\sigma_{\nu}^2}$  and the OLS estimates of  $\beta$  will be attenuated.

Under the assumptions we can use OLS to calculate the signal to noise ratios. These are estimated as  $\frac{\sigma_z^2}{\sigma_z^2 + \sigma_{\nu}^2} = 0.65 \text{ se}(0.03)$  and  $\frac{\sigma_z^2}{\sigma_z^2 + \sigma_{\eta}^2} = 0.54 \text{ se}(0.03)$ . In addition, regression estimates allow us to calculate the attenuation factor  $(\frac{\sigma_{z^2}^2}{\sigma_{z^2}^2 + \sigma_{\nu^2}^2 + 4\sigma_z^2\sigma_{\nu}^2})$  for both Hijazi's and Taghri Birdi's data. These are estimated as  $0.51 \text{ se}(0.12)$  for Hijazi's data and  $0.07 \text{ se}(0.01)$  for Taghri's data.

In addition to showing that the point estimates are likely to be severely attenuated, the estimated attenuation factors suggest that coefficients estimated using Hijazi's data should be roughly 7 times larger than those estimated using Taghri Birdi's data. Consistent with the theory, coefficients estimated using Hijazi's data are usually between 4-8 times as large as those estimated using Taghri's data suggesting that our model of measurement error is a decent approximation to reality.

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<sup>58</sup>These are stronger assumptions than necessary but are made for expositional simplicity.

## 7.2 IV Consistency

It is well known that –in general– non-linear functions of measurement error render IV estimators inconsistent (Hausman (1991, 1995), Amemiya (1985)). If we are willing to assume homoskedasticity of the error terms, however, it can be shown that instrumenting  $w_t^2$  with  $x_t^2$  (or vice-versa) will render consistent estimates in our context (we maintain the assumption that  $\eta_t, \nu_t, \varepsilon_t$  and  $z_t$  are mutually independent and are mean zero throughout the appendix unless otherwise stated).<sup>59</sup> We assume that the intercept (and possible covariates) have been partialled out<sup>60</sup> so that the regression of interest is:

$$y_t = \beta z_t^2 + \varepsilon_t$$

If we estimate  $\beta$  by the traditional IV estimator,  $\widehat{\beta}_{IV}$  converges in probability to (demeaning and independence imply  $Ez^2 = E\eta^2 = E\nu^2 = 0$ )

$$\widehat{\beta}_{IV} \xrightarrow{p} \beta \frac{E[x^2 z^2]}{E[x^2 w^2]} = \beta$$

This result requires homoskedasticity of the measurement errors (which is implied by the independence assumption). If the errors are heteroskedastic but  $E[\eta|z] = 0$ ,  $E[\nu|z] = 0$ ,  $E[\eta|\nu] = 0$  and  $E[\nu|\eta] = 0$  then the IV estimate will be biased by a factor:

$$\widehat{\beta}_{IV} \xrightarrow{p} \beta \frac{E[x^2 z_t^2]}{E[x^2 w^2]} = \beta \frac{E[z^4] + E[z^2 \nu^2]}{E[z^4] + E[z^2 \nu^2] + E[\eta^2 z^2]}$$

if we instrument for Hijazi's data and

$$\widehat{\beta}_{IV} \xrightarrow{p} \beta \frac{E[w^2 z_t^2]}{E[w^2 x^2]} = \beta \frac{E[z^4] + E[z^2 \eta^2]}{E[z^4] + E[z^2 \nu^2] + E[\eta^2 z^2]}$$

if we instrument for Taghri Birdi's data.

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<sup>59</sup>Again this is stronger than necessary but made for expositional simplicity. We also assume throughout the following that all necessary moments exist.

<sup>60</sup>Covariates are assumed to not be measured with error and to be independent of  $\eta_t, \nu_t$  (and their lags) throughout the appendix.

### 7.2.1 Distributed-Lag IV with Nile Auto-Correlation

For this section it is easier to work with matrix notation. Suppose that the intercept (and possibly other covariates) have been partialled out so that the regression of interest is

$$y = Z\beta + \varepsilon$$

where  $y$  and  $\varepsilon$  are  $(T - p) \times 1$  column vectors,  $Z$  is a  $(T - p) \times (p + 1)$  matrix with entries  $[z_0^2, z_{-1}^2, \dots, z_{-p}^2]$  (where  $z_{-k}^2$  is a  $(T - p) \times 1$  column vector with the entry in row  $t = z_{t-k}^2$  and  $\beta$  is a  $(p + 1) \times 1$  vector of coefficients). Instead of  $Z$  however, we observe the matrix  $[x_t^2, x_{t-1}^2, \dots, x_{t-p}^2] \equiv X = Z + \Xi + \Theta$

$$\text{where } \Xi \equiv [\eta_t^2, \eta_{t-1}^2, \dots, \eta_{t-p}^2], \Theta \equiv 2[z_t\eta_t, z_{t-1}\eta_{t-1}, \dots, z_{t-p}\eta_{t-p}].$$

Write

$$y = X\beta + \varepsilon - (\Xi + \Theta)\beta$$

$$\text{and } \hat{\beta}_p \rightarrow \beta - \beta(E[X'X])^{-1}E[X'(\Xi + \Theta)].$$

Suppose that we have an additional measurement of  $W$  of  $Z$  where  $W = Z + \Gamma + \Omega$ ,  $\Gamma \equiv [\nu_t^2, \nu_{t-1}^2, \dots, \nu_{t-p}^2]$  and  $\Omega \equiv 2[z_t\nu_t, z_{t-1}\nu_{t-1}, \dots, z_{t-p}\nu_{t-p}]$ . Then  $\hat{\beta}_{IV} \xrightarrow{p} (E[W'X])^{-1}E[W'Y] = \beta - \beta(E[W'X])^{-1}E[W'(\Xi + \Theta)]$ . Here we assume in addition to the previous assumption of cotemporaneous mutual independence that lags of  $z_t, \eta_t, \varepsilon_t$  and  $\nu_t$  are also mutually independent.

By the law of iterated expectations  $E[W'(\Xi + \Theta)] = E[W'E[(\Xi + \Theta)|z_t, \dots, z_{t-p}, \nu_t, \dots, \nu_{t-p}]]$  but by our independence assumption  $E[(\Xi + \Theta)|z_t, \dots, z_{t-p}, \nu_t, \dots, \nu_{t-p}] = E[(\Xi + \Theta)|z_t, \dots, z_{t-p}] = \Sigma_\eta$  (where  $\Sigma_\eta = E([\eta_t^2, \eta_{t-1}^2, \dots, \eta_{t-p}^2])$ ) and  $E[W'(\Xi + \Theta)] = \Sigma_\eta E[W'] = 0$  since we demeaned all the variables at the start ■

### 7.3 Difference-in-Difference Bias

Suppose that we are interested in the regression:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 shock_t^* + \beta_3 shock_t^* * X_t + \varepsilon_t$$

where  $Y_t$  and  $X_t$  are dummy variables. The dummy variable  $shock_t^*$ , however, is measured with error. Instead of  $shock_t^*$  we observe  $shock_t$ . It can be shown that the following relationships hold:

$$\hat{\beta}_0 \xrightarrow{p} \beta_0 + \beta_2 \Pr[shock_t^* | shock_t = 1]$$

$$\hat{\beta}_1 \xrightarrow{p} \beta_1 + \beta_3 \Pr[shock_t^* | shock_t = 0]$$

$$\hat{\beta}_2 \xrightarrow{p} \beta_2 (\Pr[shock_t^* | shock_t = 1] - \Pr[shock_t^* | shock_t = 0])$$

$$\hat{\beta}_3 \xrightarrow{p} \beta_3 (\Pr[shock_t^* | shock_t = 1] - \Pr[shock_t^* | shock_t = 0])$$

$$\hat{\beta}_1 + \hat{\beta}_3 \xrightarrow{p} \beta_1 + \beta_3 (\Pr[shock_t^* | shock_t = 1])$$

$$\hat{\beta}_2 + \hat{\beta}_3 \xrightarrow{p} (\beta_2 + \beta_3) (\Pr[shock_t^* | shock_t = 1] - \Pr[shock_t^* | shock_t = 0])$$

and as long as  $\Pr[shock_t^* | shock_t = 1] > \Pr[shock_t^* | shock_t = 0]$  the estimates will be attenuated. This will be true as long as (by Bayes rule)  $\Pr[shock = 1 | shock^* = 1] > \Pr[shock^* = 1]$ . This is a quite low bar since we set  $\Pr[shock^* = 1] = 0.05$  and  $\Pr[shock = 1] = 0.10$  in our examples. Indeed, the calculated probabilities of  $\Pr[shock = 1 | shock^* = 1]$  using Hijazi's data, estimates of the error variance and the Nile variance (from Hausman et al's algorithm) are considerably above the 0.05 and 0.1 cutoffs (assuming Nile shocks and the errors are normally distributed).

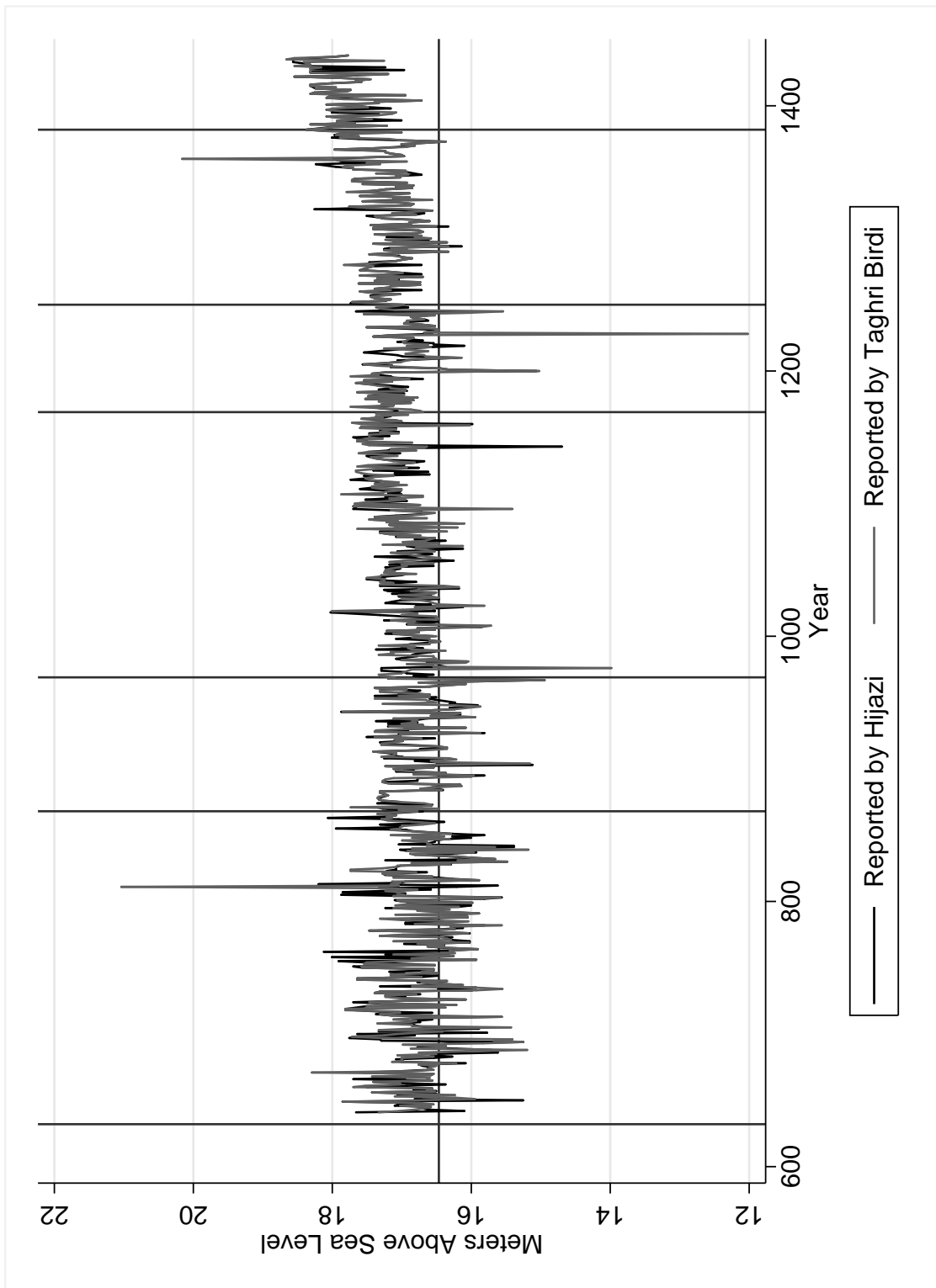
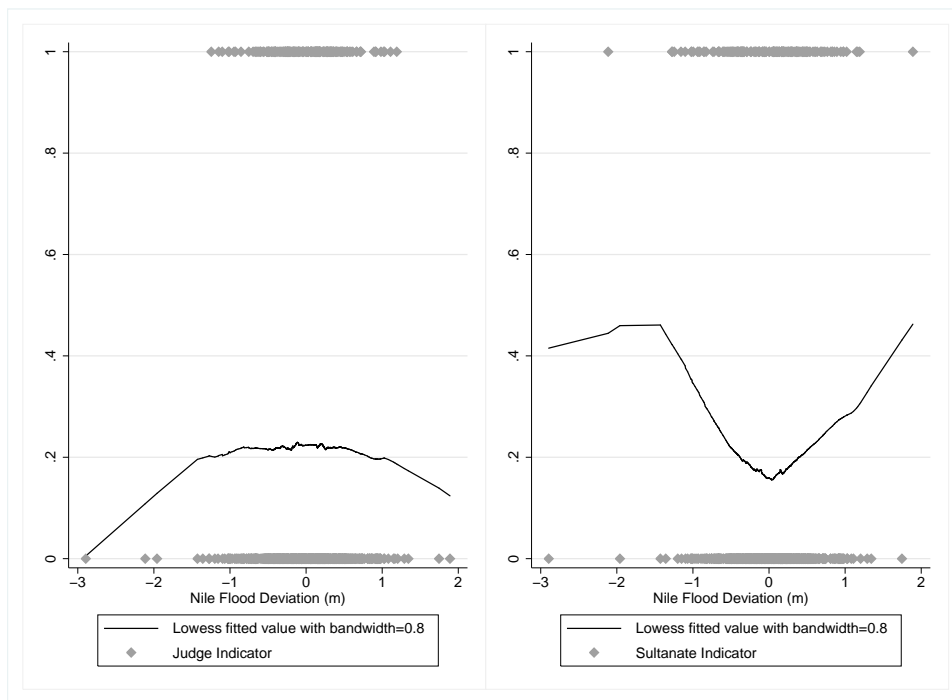


Figure 1: **Highest Measured Crest of Nile in Meters above Sea Level**  
 Vertical Lines Mark Dynasty Changes, Horizontal line Marks “Plenitude”



**Figure 2: Nile Variation and Probability of Change**  
 Graphs detail (raw) non-parametric relationship between changes in the Judgeship and Sultanate and Nile deviation

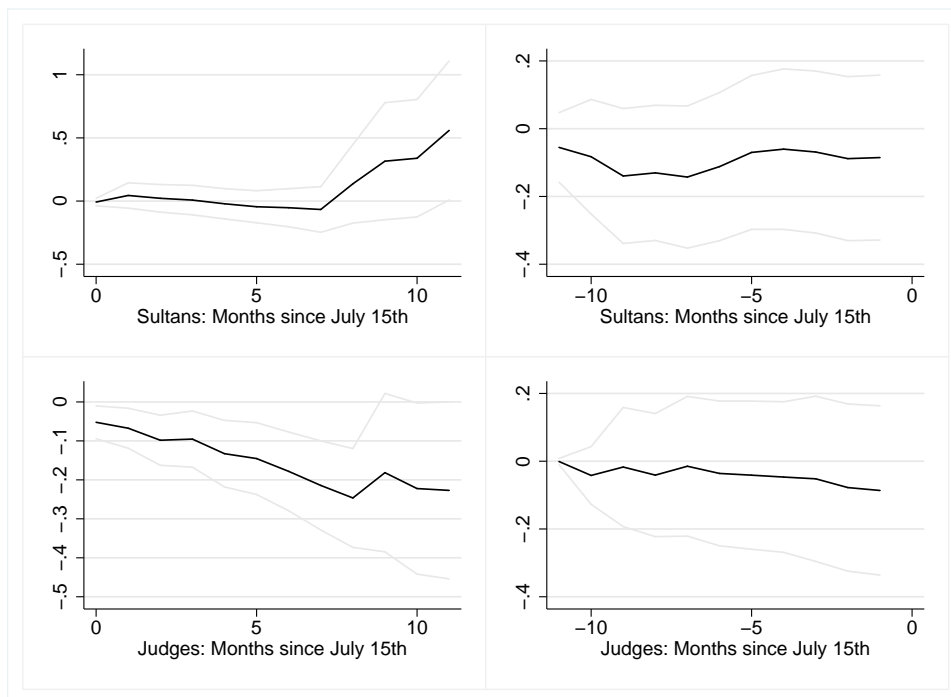


Figure 3: **The Timing of Change: Hijri Months Since Flood**  
Summation of Monthly Coefficients: see text for details

Table 1: **Summary Statistics**

<i>Variable</i>	<i>Description</i>	<i>Mean</i>	<i>Min/Max</i>	<i>St.Dev</i>	<i>N</i>
		(1)	(2)	(3)	(4)
<b>Nile</b>					
<i>TaghriBirdi</i> <sup>1</sup>	Nile Crest (m)	16.98	12.02/21.04	0.62	817
<i>Hijazi</i> <sup>1</sup>	Nile Crest (m)	16.98	14.70/18.60	0.58	789
<b>Political Changes</b>					
<i>Sultan</i> <sup>2</sup>	Sultan Change	0.19	0/1	0.40	823
Judge	Judge Change	0.22	0/1	0.41	823
<b>Dynasty</b>					
Province	(640-868 CE)	0.28	0/1	0.45	823
Tulinid/Ikhshidid	(868-969)	0.13	0/1	0.33	823
Fatimid	(969-1169)	0.25	0/1	0.43	823
Ayyubid	(1169-1250)	0.10	0/1	0.30	823
Burgi	(1250-1382)	0.07	0/1	0.26	823
Bahri	(1382-end)	0.17	0/1	0.37	823

Notes: unit of observation is one lunar (Hijri) year

1: Data between 640 CE (20 h) (start of Muslim conquest of Egypt) and 1438 CE (843 h) (end of Judge data). Alternative “skip years” account for the differences in reported values. See text for details.

2: Depending on the dynasty some rulers were also governors or caliphs

Judge: denotes a change in the head judge of Egypt (Qadi al-Qudat)

Table 2: **The Effect of Economic Catastrophes on the Sultanate**  
100\*Indicator variable equalling one if the Sultanate changed hands at least once in hijri year t

	<i>Sultan</i>	<i>Sultan</i>	<i>Sultan</i>	<i>Sultan</i>	<i>Sultan</i>	<i>Sultan</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Panel 1 (OLS)</b>						
$(Hijazi)^2$	10.39 (4.02)		6.23 (3.67)		8.85 (5.69)	
$(Taghri)^2$		2.05 (1.73)		1.75 (1.40)		0.96 (1.41)
<b>Panel 2</b>						
<b>(Hausman et al.)</b>						
$(Taghri)^2$		14.75 (11.41)		16.50 (11.32)		19.21 (11.96)
<b>Panel 3 (IV)</b>						
$(Hijazi)^2$	30.66 (21.57)		27.98 (20.29)		18.90 (20.31)	
$(Taghri)^2$		20.45 (6.77)		12.58 (6.61)		15.61 (6.22)
First Stage						
$(Hijazi)^2$		0.51 (0.09)		0.50 (0.10)		0.57 (0.15)
$(Taghri)^2$	0.07 (0.01)		0.06 (0.01)		0.05 (0.01)	
<i>N</i>	823	823	823	823	485	485
<i>DynastyDummies?</i>	No	No	Yes	Yes	Yes	Yes
<i>After 969?</i>	No	No	No	No	Yes	Yes

Notes: Panel 2 presents estimates using the algorithm proposed in Hausman et al. (1991,1995) to address non-linear functions of variables measured with error.

Standard errors in panels 1 and 3 are clustered by gregorian year. Standard errors in panel 2 are bootstrapped using the non-parametric bootstrap with 400 replications

Sultan: Indicator variable equal to one if at least one sultan was changed in a given year

$(Hijazi)^2$ : Squared yearly deviations from long-term Nile flood trend calculated using data reported by Hijazi

$(Taghri)^2$ : Squared yearly deviations from long-term Nile flood trend calculated using data reported by Taghri Birdi

Table 3: **The Effect of Economic Catastrophes on the Judiciary**  
 100\*Indicator variable equalling one if the judgeship changed hands at least once in hijri year t

	<i>Judge</i> (1)	<i>Judge</i> (2)	<i>Judge</i> (3)	<i>Judge</i> (4)	<i>Judge</i> (5)	<i>Judge</i> (6)
<b>Panel 1 (OLS)</b>						
$(Hijazi)^2$	-4.18 (2.27)		-6.06 (2.34)		-7.68 (3.43)	
$(Taghri)^2$		-1.17 (0.40)		-1.32 (0.47)		-1.52 (0.71)
<b>Panel 2</b>						
<b>(Hausman et al.)</b>						
$(Taghri)^2$		-10.20 (7.24)		-16.06 (11.10)		-16.69 (14.15)
<b>Panel 3 (IV)</b>						
$(Hijazi)^2$	-17.55 (10.00)		-21.12 (10.25)		-29.93 (14.95)	
$(Taghri)^2$		-8.23 (4.93)		-12.24 (5.52)		-13.56 (7.00)
<b>First Stage</b>						
$(Hijazi)^2$		0.51 (0.09)		0.50 (0.10)		0.57 (0.15)
$(Taghri)^2$	0.07 (0.01)		0.06 (0.01)		0.05 (0.01)	
<i>N</i>	823	823	823	823	485	485
<i>DynastyDummies?</i>	No	No	Yes	Yes	Yes	Yes
<i>After 969?</i>	No	No	No	No	Yes	Yes

Notes: Panel 2 presents estimates using the algorithm proposed in Hausman et al. (1991,1995) to address non-linear functions of variables measured with error.

Standard errors in panels 1 and 3 are clustered by gregorian year. Standard errors in panel 2 are bootstrapped using the non-parametric bootstrap with 400 replications

Judge: Indicator variable equal to one if at least one judge was changed in a given year.

$(Hijazi)^2$ : Squared yearly deviations from long-term Nile flood trend calculated using data reported by Hijazi

$(Taghri)^2$ : Squared yearly deviations from long-term Nile flood trend calculated using data reported by Taghri Birdi

Table 4: **The Relationship Between Church (Judiciary) and State**  
100\*Indicator variable equaling one if at least one Judge (Sultan) was dismissed in year t

	(1)	(2)
$\alpha \equiv E[Judge Shock = 1, Sultan = 1]$	29.41 (11.08)	29.63 (8.81)
$\beta \equiv E[Judge Shock = 1, Sultan = 0]$	3.85 (3.78)	14.55 (4.77)
$\gamma \equiv E[Judge Shock = 0, Sultan = 1]$	26.95 (3.78)	26.72 (3.91)
$\delta \equiv E[Judge Shock = 0, Sultan = 0]$	21.28 (1.64)	21.15 (1.67)
$\beta - \delta$	-17.44 (4.12)	-6.60 (5.05)
$\gamma - \delta$	5.67 (4.12)	5.57 (4.26)
$\alpha - \beta - (\gamma - \delta)$	19.90 (12.47)	9.51 (10.93)
$\alpha \equiv E[Sultan Shock = 1, Judge = 1]$	83.33 (15.89)	50.00 (9.77)
$\beta \equiv E[Sultan Shock = 1, Judge = 0]$	32.43 (6.40)	28.79 (4.81)
$\gamma \equiv E[Sultan Shock = 0, Judge = 1]$	21.84 (2.95)	21.34 (3.05)
$\delta \equiv E[Sultan Shock = 0, Judge = 0]$	17.00 (1.58)	16.64 (1.63)
$\beta - \delta$	15.44 (6.59)	12.15 (5.08)
$\gamma - \delta$	4.84 (3.35)	4.70 (3.46)
$\alpha - \beta - (\gamma - \delta)$	46.06 (17.46)	16.51 (11.42)
$N$	823	823

Notes: Standard errors clustered by Gregorian year.

Shocks are defined equal to 1 if the absolute value of the Nile deviation as measured by Hijazi is greater than the 95% or 90% respectively

Table 5: **The Length of the Effect: Distributed Lag**  
100\*Indicator variable equaling one if at least one Judge (Sultan) was dismissed in year t

	<i>Judge</i>	<i>Judge</i>	<i>Sultan</i>	<i>Sultan</i>
	(1)	(2)	(3)	(4)
<b>Panel 1 (OLS)</b>				
$\beta_0$	-5.61 (2.30)	-7.15 (3.23)	5.87 (3.69)	9.46 (5.82)
$\sum_{i=0}^1 \beta_i$	-9.64 (3.16)	-11.08 (4.48)	3.74 (4.60)	3.91 (6.05)
$\sum_{i=0}^2 \beta_i$	-9.01 (4.34)	-19.95 (8.81)	6.56 (5.75)	1.47 (6.15)
$\sum_{i=0}^3 \beta_i$	-13.80 (4.78)	-26.00 (6.09)	7.74 (6.44)	0.60 (6.61)
$\sum_{i=0}^4 \beta_i$	-12.54 (5.50)	-24.35 (7.31)	5.60 (6.94)	-1.57 (6.88)
$\sum_{i=0}^5 \beta_i$	-10.64 (6.46)	-20.83 (8.72)	4.84 (7.55)	1.42 (7.79)
<b>Panel 2 (IV)</b>				
$\beta_0$	-11.26 (7.19)	-8.23 (7.05)	9.15 (7.99)	18.89 (6.27)
$\sum_{i=0}^1 \beta_i$	-12.41 (7.99)	-13.56 (9.22)	0.96 (10.70)	8.12 (7.10)
$\sum_{i=0}^2 \beta_i$	-12.53 (8.42)	-30.17 (11.54)	10.82 (10.72)	5.37 (7.64)
$\sum_{i=0}^3 \beta_i$	-23.39 (9.53)	-40.19 (12.09)	11.01 (10.46)	4.69 (8.59)
$\sum_{i=0}^4 \beta_i$	-17.87 (11.22)	-38.46 (12.49)	7.53 (10.69)	0.34 (9.78)
$\sum_{i=0}^5 \beta_i$	-16.88 (8.91)	-34.27 (14.09)	7.24 (11.31)	4.32 (11.14)
<i>After 969?</i>	No	Yes	No	Yes
<i>N</i>	818	484	818	484

Judge: Indicator variable equal to one if at least one judge was changed in a given year.  
Sultan: Indicator variable equal to one if at least one sultan was changed in a given year.  
Notes: Standard errors clustered by Gregorian year.