# Taxing Unwanted Populations: Fiscal Policy and Conversions in Early Islam

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June 26, 2018

**Abstract**

Hostility towards a population, whether on religious, ethnic, cultural or socioeconomic grounds, confronts rulers with a trade-off between taking advantage of population members' eagerness to maintain their identity and inducing them to "comply" (conversion, quit, exodus or any other way of pleasing the hostile rulers). This paper first analyzes the rulers' optimal mix of discriminatory and non-discriminatory taxation, both in a static and an evolving environment. It thereby derives a set of unconventional predictions. The paper then tests the theory in the context of Egypt's conversion to Islam after 641 using novel data sources. The evidence is broadly consistent with the theoretical predictions.

*Keywords:* Islam, poll tax, hostile taxation, Laffer curve.

*JEL numbers:* H2, N45, Z12.

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"Muhammad was sent as a prophet and not as a tax collector."

Umar II, Caliph of the Arab Umayyad Empire from 717 to 720

# 1 Introduction

## 1.1 Motivation and main insights

Hostility toward populations on the ground of their religious, ethnic, linguistic, cultural, economic, or sexual-orientation identity is commonplace. At the core of this paper is a basic conflict faced by rulers in the treatment of these unwanted populations, between extracting members' willingness to pay for keeping their identity and inducing them to lose it (convert, assimilate, quit the organization or the country...). For instance, populist governments face a trade-off between pandering to their constituency's hostility toward rich entrepreneurs and executives and risking their moving activities abroad. This dilemma can also be found in organizations such as corporations, universities or political parties, as management may be torn between reducing the influence of individuals or groups standing in the way of the management's policy, and the loss and disruption that their departure would create. More dramatically, the persecution of Jews by Nazi Germany reflected the regime's revealed preference for expressing its strong hostility toward the minority over the substantial economic and moral cost inflicted on the country by the holocaust and the Jewish exile to the United States and other countries. [1]

Our lead application is taxation in the aftermath of the Arab conquest of the then-Coptic Christian Egypt in 641 CE. From 641 until 750, the Arab Caliphate introduced a tax system that provided incentives to Egypt's Copts to convert to Islam. [2] Taxation consisted of both a discriminatory tax, levied on non-Muslims and removed upon the taxpayer's conversion to Islam, and a non-discriminatory (uniform) one that was paid regardless of the taxpayer's religion. The discriminatory tax was made of a poll tax on non-Muslim free adult males. In addition, non-Muslim landholders were initially subject

1. Moser et al. (2014) analyzed the cost to Nazi Germany of the emigration of Jewish scientists to the US.

2. The tax system was in fact introduced to all the conquered territories of the Arab Caliphate and to all Muslim-ruled territories in South and Southeast Asia. We limit ourselves to Egypt because it is where the papyrological records on taxation under the Early Arab Caliphate survived. We also focus on Copts, rather than other non-Muslim groups in Egypt: Jews and non-Coptic Christians, because Copts constituted the vast majority of Egypt's population on the eve of the Arab conquest.

to a land tax rate (*kharaj*) that was higher than the uniform land tax rate (*ushr*) on Muslim landholders. By 750, the Caliphate, supported by jurists, increased the uniform land tax paid by converts from the *ushr* rate to the *kharaj* rate, and from that date on the discriminatory tax equated with the poll tax. This "new" Islamic tax system was enforced from 750 until 1856, when the poll tax on non-Muslims was finally abolished. Saleh (2018) documented that because the poll tax (the discriminatory tax from 750 to 1856) was regressive, *poorer* Copts were more likely to convert to Islam, holding Copts' religiosity constant.[3] This led Copts to shrink into a better-off minority by 1200, and the consequent Coptic-Muslim socioeconomic gap persisted through the nineteenth century, due to group restrictions on access to skills.

This paper is inspired by two intriguing puzzles in the history of taxation under the early Arab Caliphate. First, was the discriminatory tax on the downward-sloping "wrong" side of the Laffer curve? Umar II's citation at the beginning of the paper illustrates the trade-off between rent extraction and non-material incentives; the Caliph called for more conversions at the cost of a lower tax revenue, suggesting that public finances were indeed on the wrong side of the Laffer curve.[4] Furthermore, historians have long noted that discriminatory tax revenues declined between 641 and 750, although the tax rate remained constant, suggesting that the tax base was shrinking due to widespread conversions to Islam (Figure A.2 in the Online Appendix). Yet, we lack a theoretical framework that allows us to test this hypothesis (or historical narrative) empirically. Second, why did the Caliphate eventually increase the uniform tax on converts starting from 750? If this was meant to compensate for the decline in discriminatory tax revenues, why did Caliphs have to wait for more than a century, and to tolerate a decline in revenues, before this necessary step?

**Theory** We first develop an optimal taxation framework of general interest. Its theoretical novelty resides in part in the ruler's preferences. The normative public finance and political economy literatures both assume that the public decision-maker at least partly internalizes the welfare of, or values the votes of all constituencies; at worst the ruler has a neutral attitude toward a particular constituency. By contrast, we allow for unwanted

3. The poll tax was imposed in three lump-sum amounts of 1, 2, and 4 dinars based on the skill level of occupations: unskilled manual, skilled manual, and white-collar occupations. Despite the three-bracket system, the poll tax rate per dinar of income was decreasing in income (Saleh, 2018).

4. Note that "prophet" in Arabic means that Muhammad was sent by God to convert people to Islam.

groups. In the language of the Islamic governance of Egypt, the ruler may be hostile to those holding Coptic beliefs. Alternatively, regardless of affinity considerations, the ruler may have extrinsic (formal or informal incentives provided by the caliphate) motivations to increase the number of conversions to Islam.

In our framework, the ruler optimally levies both a uniform tax and a discriminatory (unwanted-population-specific) tax. We derive the conditions under which the discriminatory tax falls on the downward-sloping "wrong" side of the Laffer curve. This specificity produces a rich set of insights, including simple but unconventional ones. Most importantly, when on the wrong side of the Laffer curve the ruler taxes more his favored group, the more hostile he is toward the unwanted group (or more religious in the Muslim sense), but the result is reversed when on the upward-sloping "correct" side of the Laffer curve. Relatedly, the uniform and the discriminatory taxes are under some conditions complements rather than substitutes; consequently, a relaxation of a cap on the uniform tax leads to an increase in the discriminatory tax.

Other testable predictions describe how the choice of taxes and the unwanted population's compliance level (in our lead example, conversion to Islam) vary with the population's socio-demographic characteristics (income and religiosity). We further show that the need to prevent revolts lowers both the discriminatory and non-discriminatory taxes, even when the marginal potential rebel renounces his identity (is a convert) and therefore is not affected by the discriminatory tax.

Looking at the dynamics of optimal taxation, we then show that the uniform tax, but not necessarily the discriminatory tax, may increase over time for four different reasons: (a) the budgetary need increases and this increase is absorbed by the uniform tax; (b) the rulers become more hostile over time (by contrast, the uniform tax remains constant if the rulers become more tolerant over time, an asymmetric response); (c) there is some possibility that the rulers be chased out of power (out of the country), creating an option value for remaining in the unwanted population; (d) the threat of rebellion weakens over time since past converts only economize on the uniform tax but not on the discriminatory tax when the rebellion succeeds (they have lower incentives to participate in a rebellion). [5] The last result is particularly interesting as it exhibits natural dynamics in an otherwise completely stationary environment.

5. The last result, suggesting a dynamic "divide-and-conquer" strategy, is of broad interest and can be applied to a broad array of political strategies.

**Empirics** We present local-level cross-sectional evidence on the model, where we exploit the geographic variation in poll and *kharaj* tax rates (which were the discriminatory and uniform taxes respectively, starting from 750) and conversions within Egypt under the early Arab Caliphate. We focus on the key insight of the model, which allows us to test if the optimal discriminatory tax was on the wrong side of the Laffer curve: More religious tax authorities will impose a higher uniform tax. This is because their religious fervor will trigger them to impose a higher discriminatory tax on the unwanted population, in order to induce more conversions. Being on the wrong side of the Laffer curve, however, the consequent fall in tax revenues will necessitate an increase in the uniform tax in order to meet a fixed budgetary target. Whereas the model predicts other determinants of the discriminatory and uniform tax rates and conversions, including Copt religiosity and income, budgetary needs, threat of rebellion, uncertainty about Caliphate's rule, and the cap on uniform tax, these predictions either do not change whether on the wrong or correct sides of the Laffer curve, or are unlikely to vary locally.

The local-level evidence is based on novel primary data sources. We constructed an individual-level dataset on poll and *kharaj* tax payments per person from Egypt's papyrological tax records in 641-1100. Conversions between 641 and 1200 are measured at the village level by the presence of Coptic churches and monasteries in 1200. We proxy for the religiosity of local tax authorities by Arab settlement in 700-969 under the presumption that constituencies that received Arab tribes witnessed greater Arab (Muslim) penetration into the local tax administration (hence, more religious authorities), compared to Coptic-administered areas. We attempt to control for Copt religiosity in a given constituency, which is captured by being located (or not) on the legendary route of the Holy Family during its biblical visit to Egypt, and for Copt income by urban population circa 300.

We estimate a separate set of OLS regressions for each outcome: poll tax, *kharaj* tax, and conversions, on Arab settlement. To address the potential endogeneity of Arab settlement, we employ distance to the point of entry of the Arab army into Egypt during the conquest as an instrumental variable for settlement. The analysis is subject to two major caveats, though. First, the poll (*kharaj*) tax records survived for only 4 (respectively 7) out of 42 *kuras*, Egypt's administrative units in 641-1036. Second, most papyri are dated within a period, such as a century or longer, rather than a specific date, which forces us to

date the tax papyri between 641 and 1100, without being able to disentangle the pre-750 tax papyri from the post-750 period. Third, the *kharaj* tax is measured per person and not per unit of land, and thus confounds local variation in landholding distribution with variation in tax rates. While there is little that we can do to address these caveats, there are two points to make here. First, this is a general limitation of papyrological evidence in ancient and medieval history where the papyri usually survived in a handful of areas (mostly in Egypt's dry-climate Nile Valley), but this cost has to be weighed against the benefit of employing factual administrative records from the period instead of (often) subjective historical narratives. Second, the proxy for conversions (churches) is observed for all 42 *kuras*.

Our findings are broadly consistent with the optimal discriminatory (poll) tax being on the wrong side of the Laffer curve. We document that taxpayers in *kuras* where Arabs settled in 700-969 faced, on average, higher poll and *kharaj* taxes per person (observed in 641-1100), and that villages in these *kuras* were less likely to have at least one Coptic church or monastery in 1200 (more conversions).

Finally, we introduce country-level evidence to explain the increase in the uniform tax rate circa 750. The model explains the increase in the uniform tax rate starting from 750 by an increase in Caliph's religiosity and/or budgetary needs, and/or by a decrease in the threat of rebellion and/or uncertainty about Muslim rule. The country-level evidence documents the evolution of (proxies for) the four variables between 641 and 847. However, the evidence is qualitative because we observe tax rates and conversions at only a few scattered points in time that do not allow an econometric analysis, and because the tax reform was a Caliphate-wide one-time policy change. The evidence suggests that the tax reform is attributable to the decline in uncertainty about Caliphate's rule and in the (exogenous and endogenous) threat of rebellion. As attacks by neighboring empires and major civil wars within the Caliphate both declined, and as the population share of converts increased, the Caliphate became more daring to increase the land tax on Muslims. Although the reform resulted in tax revolts that now included both Muslims and Copts, the success of the violent suppression of these revolts allowed the new tax system to survive until the nineteenth century.

## 1.2 Related literature

The paper is related to a few strands of literature. It differs from the optimal taxation literature in at least two ways: the optimality of being on the wrong side of the Laffer curve and the hysteresis effects associated with exit from the tax base. Relative to the economics of discrimination literature, the paper shares with Becker (1957)'s theory of discrimination the feature that decision-makers have a distaste for minority membership: Becker's employers (or their majority employees) are assumed to derive a lower utility from minority employees at the same productivity and wage. Similarly, the ruler here dislikes the minority, but values its presence in the tax base. The theory of taste-based discrimination however is developed in a competitive labor market (actually, one of Becker's key insight was to show that for a given productivity, majority and minority wages are equalized whenever the fraction of employers with a taste for discrimination is smaller than some threshold), while our ruler acts as a monopolist. Glaeser (2005) analyzes the economics of hatred, but from a very different angle: he looks at the majority politicians' incentives to spread negative information about a minority. The majority members can choose to verify the veracity of this information, can decide to protect themselves against the minority and also vote for or against the majority politician. Neither the optimal tax mix nor the dynamic implications of discriminatory treatments are examined in that literature.

Acemoglu (2006) is a rare contribution in which rulers have reasons to hurt some constituency. In his model, the ruling elite not only aims at extracting rents from the output of an enterprising middle-class, but also may try to achieve other goals with the tax it levies on the output of the middle-class. First, the elite may itself own firms and taxing the middle-class output discourages middle-class production and reduces the market wage. So the elite may levy a tax on middle-class output in excess of the level that extracts the maximum rent from them. As Acemoglu emphasizes, this result hinges on limited tax instruments, i.e. on the output tax achieving multiple purposes; a tax on labor hired by the middle-class firms could take care of limiting competition for labor. By contrast, we study optimal taxation. Acemoglu's second reason for the elite's overshooting the peak of the rent-extraction curve is that the middle class might rebel, a rebellion that might be facilitated by financial means at its disposal. That reason is complementary to our section on rebellion, which is based on manpower rather than money; as a consequence,

the minority rebels when ill-treated by the majority in this paper, while it rebels when well-treated and therefore empowered in Acemoglu's contribution. Overall, both the rationales for hurting the minority and the focus differ between the two papers.

Our results on the time-decreasing threat of rebellion relate to Dewatripont and Roland (1992)'s seminal work on gradualism. These authors consider an environment in which a government wants to reduce a firm's labor force, and for that must make an offer that is preferred by a majority of workers to a given status-quo. The government does not know individual workers' outside options, and so faces a trade-off: Massive redundancies might yield rapid efficiency gains, but at a great budgetary cost (there is a shadow cost of public funds). Dewatripont and Roland show that, with two periods, it is possible for a government to obtain a majority vote for a reform that intertemporally hurts majority interests. Some voters expect to lose in comparison to the status quo if the initial reform is rejected. It is then possible for the government to include this second-period minority in its first-period majority, and use it to hurt another group of workers who become the first-period minority. There are a number of differences between their framework and ours. First, their model exhibits negative selection (and associated Coasian dynamics) rather than positive selection. Second, converts in our model can still be taxed in the future, while workers who have accepted the exit bonus disappear from the game in their paper. Third, a Copt's ability to convert does not hinge on other Copts' decisions, while a worker's ability to quit depends on the approval of the government package by a majority of other workers. Finally, Dewatripont and Roland's planner is benevolent and in no case hostile to the population whose status it is trying to alter.

Our paper shares with the literature on the taxation of externalities and internalities (e.g. tobacco or pollution) the property that taxes will be on the wrong side of the Laffer curve. This literature however does not study issues related to the tax structure and to the specific dynamics of taxation and rebellion under ratcheting of compliance (apostasy, costly return...); it also cannot guide the empirical evidence obtained in this paper.

A large literature studies optimal taxation with non-utilitarian welfare functions (e.g. Fleurbaey and Maniquet (2011)). Saez and Stantcheva (2016) derive optimal taxation in an environment that is not necessarily welfarist (in particular, social welfare weights can depend on individual or aggregate characteristics which do not enter individuals' utilities). Their focus is on allowing various considerations, such as counterfactuals (what

would have happened in the absence of taxes?), horizontal equity, libertarianism, equality of opportunity concerns, and poverty alleviation, to matter per se, independently of their consequences on the taxpayers' utility. Much work has also been devoted to investigate the impact of altruism on optimal taxation (e.g. Diamond (2006), Farhi and Werning (2010), and Kaplow (1995)). These two literatures investigate neither the taxation of unwanted populations, nor its dynamic evolution as unwanted population members convert or leave the country.

The paper contributes to the literature on the economics of religion (Barro and McCleary, 2003; Botticini and Eckstein, 2005; Becker and Woessmann, 2009; Chaudhary and Rubin, 2011; Michalopoulos et al., 2017) and the relative roles of political and religious authorities in shaping population's religious beliefs in order to establish legitimacy for their rule (Greif and Tadelis, 2010; Chaney, 2013; Belloc et al., 2016; Rubin, 2017). Instead of focusing on the impact of religious beliefs on economic outcomes, our paper demonstrates how the Islamic tax system affected the *formation* of religious groups via inducing conversions to Islam (although not necessarily triggering changes in religious beliefs). This tax system was probably established in order to increase the legitimacy of the Caliphate by pursuing its Islamic mission of winning converts.

The paper contributes to a century-long debate on the historiography of taxation and conversions under the early Arab Caliphate. Whereas Muslim jurists claimed that the canonical Islamic tax system that exempts Muslims from the poll tax but forces them to pay the (higher) *kharaj* land tax had *always* existed since Muhammad's lifetime (before 632), there is a general consensus among Western historians (Wellhausen, 1902; Becker, 1902; Bell, 1910; Grohmann, 1932; Morimoto, 1981; Simonsen, 1988; Frantz-Murphy, 2004) (but not Dennett (1950)) that the system was introduced during the eighth century and that Muslims paid a lower (even zero) land tax before then. Within the latter viewpoint, it was suggested that the eighth-century tax reform was the Caliphate's response to the trade-off between winning converts and maximizing tax revenues. According to Sijpesteijn (2013, p. 189), "*the question is now whether the Muslim authorities would have had reasons to start levying these* [higher land] *taxes on Muslims in the first quarter of the second century AH* [mid eighth century CE]. *The answer lies in the early Umayyad fiscal system and the problems it faced trying to ensure a continuous source of fiscal income while simultaneously serving the Muslim mission to win converts.*" Our paper provides

theoretical and empirical support to the latter viewpoint by arguing that both Islamic taxation and conversions evolved endogenously. Specifically, our local-level evidence from Egypt suggests that the religiosity of local tax authorities and the religiosity and income of taxpayers impacted both taxation and conversions. Furthermore, our time-series evidence suggests that the eighth-century tax reform was likely driven by a decline in the threat of rebellion (which decreased over time due to conversions) and in the uncertainty about Muslim rule.

We also contribute to another long-standing, and more controversial, debate on the impact of discriminatory taxation on conversions in early Islam. Inspired by major papyri discoveries from early Islamic Egypt, pioneering work by historians such as Wellhausen (1902), Becker (1902), Bell (1910), and Grohmann (1932) emphasized the tax incentive of conversions under the early Arab Caliphate. Their theory triggered fierce debates among later historians, though, and the question is thus far unresolved. While Saleh (2018) provided evidence on the impact of the poll tax (discriminatory taxation) on conversions, our paper argues further that both taxation and conversions were outcomes of characteristics of tax authorities and taxpayers.

More generally, the paper is connected to the institutional literature in the economic history of the Middle East. Certain Islamic institutions, such as the Islamic trust (*waqf*) and inheritance, have been criticized for causing the relative economic stagnation of the region (Kuran, 2004, 2012). Although explaining the emergence of institutions is a major topic in the institutional economics literature (Greif, 1994), it received less attention in the literature on the Middle East, which usually treats Islamic institutions as exogenous assuming that they have always existed since the beginning of Islam. Our paper attempts to endogenize the Islamic tax system and explain its historical formation.

# 2 Historical background

## 2.1 Islamization of Egypt, Greater Syria, and Iraq

Following Prophet Muhammad's death in 632, the Rashidun and Umayyad Arab caliphates that ruled from 632 to 750 initiated a series of conquests that captured the Persian Empire and the southern and eastern parts of the Byzantine Empire. On the eve of the Arab conquests, all local populations of the conquered territories were non-

Muslims (a large Christian majority and a small Jewish minority).[6] During the centuries that followed, non-Muslims shrank from 100 percent of the local population to 7 percent in Egypt in 1848-1868, and 9 percent in Greater Syria and 5 percent in Iraq in 1580.[7] Courbage and Fargues (1997)'s estimates are based on the total poll and land tax revenues assuming complete tax enforcement, while Saleh (2018)'s estimates are based on the share of Egypt's villages that had at least one Christian church or monastery in 1200 and 1500. The figure reveals that non-Muslims shrank into a minority by 900.

Historical evidence indicates that Islamization of the Middle East was mostly driven by voluntary conversions of the local population to Islam rather than by coercion or demographic factors including population replacement via Arab immigration and local populations' emigration, fertility and mortality differences between Muslims and non-Muslims, and inter-marriages between Muslim males and non-Muslim females (Saleh, 2018). Therefore, from now on we use the two words "Muslims" (who in principle include both Arabs and converts) and "converts" interchangeably. Conversion to Islam was automatically transmitted across generations (i.e. being a Muslim was an "absorbing state") owing to three Islamic laws: (a) apostates are sentenced to death, (b) the offspring of a Muslim male is automatically Muslim, and (c) Muslim females may only marry Muslim males.

## 2.2 Islamic taxation

**Taxation in 632-750** To provide incentives to the conquered populations to convert to Islam, Arabs introduced a tax system that provided tax exemptions to converts.[8] Between 632 and 750, free non-Muslim adult males paid a poll tax (*jizya*), an annual per head cash tax; furthermore, non-Muslim *landholders* paid an annual land tax (*kharaj*) that was assessed as a lump-sum amount per *feddan* (= 6,368 square meters) of land-

6. Christians of the region belonged, for the most part, to "heretical" Oriental Orthodox non-Chalcedonian Christian denominations, that split from the Roman Church at the Council of Chalcedon in 451: Egypt's Christians mostly followed the Coptic Church; Greater Syria's Christians, the (Jacobite) Syriac Church, and Iraq's Christians, the Nestorian Church. Chalcedonian denominations that remained loyal to the Roman Church formed small Christian minorities in these territories: the *Melkites* in Egypt and the *Maronites* in Greater Syria (Courbage and Fargues, 1997).

7. Courbage and Fargues (1997)'s estimates of non-Muslims' population share in Egypt, Greater Syria, and Iraq, along with Saleh (2018)'s estimates for Egypt, are shown in Figure A.1 in the Online Appendix.

8. Taxes were collected locally and sent to the capital of each territory (e.g. Egypt, Greater Syria, and Iraq), where part of the revenues was forwarded to the Caliphate's capital (Medina in 632-661, Damascus in 661-750, and Baghdad, Cairo, and Istanbul (among other capitals) from 750 onwards).

holdings that varied by crop and was paid in cash and/or kind. By contrast, Muslims were exempted from the poll tax, and Muslim landholders paid a reduced land tax (variously called tithe, *ushr*, *zakat*, *sadaqa*) that was assessed at a percentage of yield (5 or 10 percent) that varied by land quality and paid in cash and/or kind. Due to the lack of papyrological evidence on the *ushr* tax before 750, it has been argued that Muslim landholders actually paid no land tax before 750 (Sijpesteijn, 2013, pp. 181-99). [9]

There were two important differences between *kharaj* and *ushr* taxes. First, whereas the *de jure ushr* tax rate had an exogenously determined upper bound that was decided by *Hadith* (prophet's sayings), the *de jure kharaj* tax rate was decided by either the terms of a treaty (and thus had an exogenous upper bound) in territories that were annexed by the Arab Caliphate by a peace treaty, or by Caliph's will (and thus had no exogenous upper bound) in territories that were annexed by military force. According to Frantz-Murphy (2004), Egypt belonged to the "treaty" territories. [10] Second, landholders' rights differed between *kharaj* and *ushr* land. [11] (Non-Muslim) landholders of *kharaj* land, who were in principle tenants paying *kharaj* as rent to the state, held *usufruct* rights on land that were (a) renewable upon payment of the *kharaj*, (b) inheritable upon state approval, (c) tradable among non-Muslims only (Sijpesteijn, 2009, p.126), and (d) non-eligible to be turned into *waqf* (a form of non-taxable charitable trust). To the contrary, (necessarily Muslim) landholders of *ushr* land enjoyed full private ownership rights which were (a) permanent, (b) inheritable without state intervention, (c) tradable among Muslims only, and (d) eligible to be turned into *waqf*.

9. We abstract here from two other types of taxes. First, we abstract from the miscellaneous taxes that were imposed on non-Muslims only in 632-750 because they were extended to Muslims after 750. In 632-857, the miscellaneous taxes were irregular ad-hoc taxes collected for specific uses such as military expenses, lodging for officials, governor's expenses, the village overhead expenses, and public projects. In 857-1171, the tax base expanded for the first time (beyond the poll and land tax) to include non-land property such as pasture, weir, and various crops and products. In 1171-1856, they included taxes on pasturage, industry, mines, fisheries, trade and transactions, property, maintenance of public services, war taxes, and taxes on vice. Second, we abstract from the military conscription on Muslims (a non-pecuniary tax), because it was in return for a state (cash and in-kind) stipend and was abolished from 833 on with the Caliphate-wide shift to recruiting imported slave soldiers in the army instead of conscripting the local Muslim populations. To the best of our knowledge, there were no other *differential* taxes between non-Muslims and Muslims.

10. The actually enforced *kharaj* that we observe in the Egyptian papyri varied locally. See the discussion of the tax administration at the end of this section and Section 4.2.1.

11. Caliph Umar I (reigned from 634 to 644) prohibited Arabs from confiscating land in conquered territories. Consequently, the vast majority of land remained in the hands of the local non-Muslim populations (Sijpesteijn, 2013, p.81), on which the *kharaj* land tax was levied. Only the public domain and royal (Byzantine or Persian) land was confiscated by, and distributed among Arabs (Dennett, 1950, p.69), on which the *ushr* land tax was levied.

To sum up, the discriminatory tax in 632-750, i.e. the difference in net taxes between non-Muslims and Muslims was equal to the poll tax plus the (positive) difference between the *kharaj* and *ushr* land tax rates. The uniform tax, which was imposed on both non-Muslims and Muslims, was equal to the *ushr* tax, which might have been equal to zero.

**Tax reform in 750** Conversions to Islam in 632-750 caused the tax base and, hence, tax revenues throughout the Caliphate to fall (Figure A.2 in the Online Appendix). In order to increase the tax base, the Caliphate introduced several tax reforms during that period including (a) levying the poll tax on monks, local elites, and fugitives, who were initially exempted,[12] (b) imposing the *kharaj* land tax on churches and monasteries, which were also initially exempted,[13] and (c) imposing the *ushr* land tax on Arabs, who were initially exempted due to their political power. Furthermore, certain local governors attempted to deter conversions to Islam by imposing the poll and *kharaj* land taxes on converts, although these reforms were reversed by Caliphs.

But starting from 750, the *canonical* Islamic tax system was established by the Caliphate. Under the new system, the *de jure* land tax on Muslims was raised from the *ushr* to the *kharaj* rate, and Muslims were now allowed to purchase *kharaj* land from non-Muslims. Jurists adopted a historical narrative that denied the existence of peace treaties in most of the conquered territories, including Egypt, thus justifying removing any upper bound on the *kharaj* tax rate. Consequently, from that date on the discriminatory tax equated the poll tax, until the latter tax was finally abolished in 1856, and the uniform tax, the *kharaj* land tax, was decided upon Caliph's will.[14] Landholders of *kharaj* land, whether Copts or Muslims, enjoyed *usufruct* rights but not full private property rights on their landholdings.[15] However, the (lower) *ushr* rate continued to be imposed on certain elite Muslim landholders, who enjoyed full private property rights on their landholdings. The unification of the land tax rate only occurred in 1891.

12. Fugitives are those who deserted their tax place of residence in order to evade taxation.

13. These initial tax exemptions were likely due to the persistence of pre-Islamic Persian and/or Byzantine tax administrative traditions.

14. The exact date of the tax reform is uncertain. Wellhausen (1902) and Becker (1902) date the tax reform to the first half of the eighth century (738-748), whereas Morimoto (1981) pushes it forward to the late eighth century (775-785). The earliest *surviving* Muslim jurist book that outlined the new tax system is Abu-Yusuf (1979) that was written around 786. However, Abu-Yusuf's tax system was probably enforced earlier and in fact may have been first introduced by his teacher, Abu-Hanifa (699-767).

15. The vast majority of farmers in rural Egypt in the 1848 and 1868 population censuses were *kharaj* landholders. Sharecroppers and wage agricultural workers (who were landless farmers) constituted a tiny percentage.

***De jure* Tax rates** Figure A.3 shows the long-term trend of the *de jure* nominal annual poll tax for low-, middle-, and high-income brackets. In 641-750, the poll tax was 1 dinar on average. Starting from 750, the *de jure* poll tax was imposed in three lump-sum amounts per person of 1, 2, and 4 dinars on the poor, middle, and rich respectively, but was regressive in wages (Saleh, 2018). The *de jure* poll tax remained almost stable from 750 to 1000, increased slightly between 1101 and 1300, before it declined in 1301-1500, possibly due to the Black Death shock. By contrast, the *de jure real* poll tax rate per person and the *de jure* poll tax rate per dinar of income both declined over time, and became negligible after 1250, because the nominal tax did not increase, the purchasing power of the dinar declined, and nominal wages increased (Saleh, 2018).[16] Figure A.4 in the Online Appendix shows that the *de jure ushr* land tax rate was constant over time (by Islamic jurisprudence), whereas the *de jure kharaj* land tax (that was collected in cash, kind, or both) fluctuated at the discretion of tax authorities. The *de jure kharaj* rate (adding up both the cash and in-kind components) was higher than the *de jure ushr* rate.

**Tax administration and *actually enforced* tax rates** Tax assessment and collection were delegated to the local authorities of each *kura*. In 641-720, Arabs everywhere left taxation in the hands of existing Coptic rural elites. But from 720 on, they started to penetrate the local tax administration by increasingly appointing Arabs as headmen of *kuras* (Morimoto, 1981, pp. 66-91; 175-81). In response to a series of tax revolts between 726 and 866 (first by Copts, then by both Copts and Muslims), they resorted around 900 to tax farming (Sijpesteijn, 2009) that remained in effect until 1813. Under that system, the state contracted out the tax collection of each *kura* to individuals (Morimoto, 1981, pp. 231-3), who, in 1171-1813, were often high-ranked military officers. Egyptian tax papyri in 641-1100 reveal that the actually enforced poll and *kharaj* taxes, the discriminatory and uniform taxes starting from 750, could be higher or lower than the *de jure* ones because different tax rates could be decided locally, and because enforcement was not always perfect. However, the actually enforced tax rates that we observe in the papyri

16. A full analysis of the reasons for this decline lies beyond the scope of the paper because it took place after our period of study. However, an additional (possible) explanation, besides the Black Death epidemic, is that the Caliphate increased over time the uniform tax base, by introducing new miscellaneous taxes on items other than land and religious affiliation (Saleh, 2018), to the extent that it may have hit taxpayers' maximum ability to pay, thus leaving little room to increase the discriminatory tax.

are equal to the *de jure* ones on average.[17] We lack evidence on the actually enforced *ushr* tax, the uniform tax before 750, though, and so we do not know whether its enforcement indeed varied locally, let alone whether it was enforced at all.

# 3 Theory

## 3.1 Basic version

*Copts' religious preferences.* There is a mass 1 of Copts. Copts care about remaining Copts and about money. They are heterogeneous in their willingness to pay for remaining Copts. Let $\theta \in (-\infty, +\infty)$ denote their per-period willingness to pay for being Copt, distributed according to some smooth cumulative distribution $F(\theta)$ and density $f(\theta)$; one expects the mass to be concentrated primarily in the positive domain ($\theta > 0$). Let us assume that the hazard rate of the distribution is monotonic (a property that is satisfied by most familiar distributions): $d(f(\theta)/[1 - F(\theta)])/d\theta > 0$.

*Taxes.* For notational simplicity, we assume equal land holdings, so each Copt holds one unit of land (each piece of land yields the same output). $\lambda$ is the non-discriminatory land tax paid by all Copts, whether they convert or not (later, we will assume that $\lambda$ is constrained at the *ushr* level so as to better account for the pre-750 taxation). $\tau$ is the extra cost imposed on non-converts (empirically, this discriminatory tax exceeds the poll tax by the difference between the *kharaj* tax and the *ushr* tax until 750, but for the purpose of the model we will call it simply "poll tax").

Let

$$U(\theta) \equiv \begin{cases} -\lambda & \text{for a convert} \\ \theta - \lambda - \tau & \text{for a non-convert} \end{cases}$$

denote the gross utility of type $\theta$ (we can ignore the fixed output from land here).

A Copt converts if and only if $\theta < \theta^* = \tau$. The number of converts is therefore $F(\tau)$ and

17. The average poll tax payment in the papyrological poll tax registers and receipts in 641-1100 is 1.5 dinar ($N = 552$; $SD = 3.7$), which is close to the average *de jure* poll tax of 1-2 dinars, assuming that most taxpayers belonged to the low and middle brackets. Furthermore, the *de jure* poll tax in 1101-1856 in Figure A.3 in the Online Appendix are from officials' handbooks, which are roughly equal on average to the actual poll tax amounts (paid by Jews) that are observed in the Cairo Geniza (Goitein, 1963, p. 286). Papyrological *kharaj* tax records in 641-1100 indicate that the *kharaj* payment was on average 1.32 dinar per *feddan* of land ($N = 27$; $SD = 1.02$), which is close to the *de jure kharaj* rate of 1 dinar in 641-750.

the revenue from the poll tax paid by non-converts is

$$R(\tau) = \tau[1 - F(\tau)].$$

The monotone hazard rate assumption implies that the revenue function is strictly quasi-concave. Let $\tau^m \equiv \arg\max\{R(\tau)\}$ denote the revenue-maximizing, monopoly tax. We will say that the poll tax is on the "wrong side of the Laffer curve" if $\tau > \tau^m$. In this region, an increase in the poll tax reduces tax revenue.

*Ruler's objective function.* We posit that the ruler's objective function is quasi-linear [18] in the uniform tax $\lambda$; the ruler's preferences with respect to conversions are expressed by a function $V(\theta^*)$:

$$W(\theta^*) = V(\theta^*) - \lambda. \tag{1}$$

Comparing two rulers with respective preferences $V_1$ and $V_2$, we define:

**Definition 1** *Ruler 1 is said to be more religious than ruler 2 if* $V_1'(\theta^*) > V_2'(\theta^*)$ *for all* $\theta^*$.

We assume that the ruler maximizes $W$ subject to raising a budget $B$ for the Caliphate $\lambda + R(\tau) \geq B$, which will be binding at the optimum:

$$\lambda + R(\tau) = B. \tag{2}$$

The objective function can then be rewritten as

$$W(\theta^*) = V(\theta^*) + R(\theta^*) - B.$$

We will assume that $V + R$ is strictly quasi-concave.

*Intrinsic and extrinsic motivation lead example.* To illustrate the model, we provide a lead example in which the ruler cares about conversions either because he feels antipathy towards someone with Coptic convictions, or because he faces formal or informal incentives for inducing conversions provided by the Caliphate. We are agnostic about the

18. The theory can be extended to a non-linear objective function, but at the expense of further assumptions on marginal rates of substitution among taxes.

relative strengths of the empathy and conversion-performance factors, and so we allow both to enter the ruler's objective function. Letting $U(\theta)$ denote type $\theta$'s utility, $1-\delta(\theta)$ denote the weight of type $\theta$ in the ruler's welfare function (so $\delta(\cdot) \gtrless 0$ is a discrimination factor) [19] and $c$ denote a psychological or incentive cost $c$ for the ruler per non-convert, the ruler's welfare is (up to a constant)

$$V(\theta^*) = \int_{-\infty}^{+\infty} [1-\delta(\theta)]U(\theta)dF(\theta) - c[1-F(\theta^*)] = \int_{\theta^*}^{+\infty} [1-\delta(\theta)](\theta-\theta^*)dF(\theta) - c[1-F(\theta^*)]. \tag{3}$$

Normalize weights to be equal to 1 on average:

$$E[\delta(\theta)] \equiv \int_{-\infty}^{+\infty} \delta(\theta)dF(\theta) = 0,$$

and assume that $\delta' \geq 0$ and, for purely technical reasons, that $\delta(+\infty) \leq \bar{\delta}$ for an arbitrarily large $\bar{\delta}$. A utilitarian ruler would exhibit $\delta(\theta) = 0$ for all $\theta$ and $c = 0$ (and would choose $\tau = 0$). $W$ is strictly quasi-concave for example if $f' \geq 0$. [20]

We can compare two rulers "1" and "2", corresponding to two different costs $c_1$ and $c_2$, and weighting functions $\delta_1(\cdot)$ and $\delta_2(\cdot)$ such that

$$E[\delta_1(\theta)] = E[\delta_2(\theta)] = 0.$$

**Definition 1′** *In the intrinsic motivation illustration, ruler 1 is said to be more religious (in the Muslim sense) than ruler 2 if there exists $\theta_0$ such that $\delta_1(\theta) < \delta_2(\theta)$ for $\theta < \theta_0$ and $\delta_1(\theta) > \delta_2(\theta)$ for $\theta > \theta_0$ and if $c_1 > c_2$.*

**Definition 2′** *In the intrinsic and extrinsic motivation illustration, for a given cutoff $\theta^*$,*

*(i) the ruler is hostile to non-converts $[\theta^*, +\infty)$ if the average discrimination factor among non-converts exceeds 1 (or equivalently the average weight put on non-*

19. While type $\theta$ is unobservable by the ruler, the latter's feelings toward converts may well depend on the truncated distribution of types, as we depict. High $\theta$ converts are likely to have limited religious fervor and to pay lip-service to their new Muslim faith. Whether these considerations are at play in historical examples is a question for future research.

20. The second-order condition for concavity is $-1-(\tau-c)\frac{f'(\tau)}{f(\tau)} - \delta(\tau) \leq 0$. At a solution of the first-order condition (see section 3.2), the second-order condition for strict quasi-concavity

$$1 + \delta(\tau^*) + \frac{f'(\tau^*)}{f(\tau^*)} \frac{\int_{\tau^*}^{\infty} \delta(\theta)dF(\theta)}{f(\tau^*)} > 0.$$

A sufficient condition for $W''(\tau^*) < 0$ is $f'(\tau^*) \geq 0$.

*converts is negative):* $\int_{\theta^*}^{\infty} \delta(\theta) dF(\theta)/[1 - F(\theta^*)] > 1$

(*ii*) *the ruler is hostile to the marginal non-convert if* $\delta(\theta^*) > 1$ *(a stronger condition than the previous one), and wants to discriminate against this marginal member if* $\delta(\theta^*) > 0$.

Note the distinction between "being hostile to" (wanting to harm) and "discriminating against" (putting lower-than-average weight on the group or person, without necessarily being hostile). The latter concept is familiar from the political economy literature.

*Discussion of the model*

(a) *Alternative proselytic strategies.* Could the ruler benefit from replacing a discriminatory tax by an alternative approach such as coerced conversions? Given his ignorance of individual preferences, his ability to reach his goals is constrained by incentive compatibility, the fact that more religious Copts are necessarily less likely to convert. A straightforward generalization of the analysis in Stokey (1979) and Riley and Zeckhauser (1983) for our model shows that the ruler obtains his highest welfare through a discriminatory tax, and so there is no restriction involved in assuming this particular approach to inducing conversions.

(b) *Pressure from social norms, network externalities.* When contemplating becoming a Muslim, a Copt may take into account not only his own preferences ($\theta$) and the material incentive ($\tau$), but also the resulting perception of his choice within the Copt community. Suppose [21] that the potential convert has image concerns $\mu M^+(\theta^*)$ if he does not convert and $\mu M^-(\theta^*)$ if he does, where $\theta^*$ is the threshold type and $\mu \geq 0$ is a parameter of intensity of image concerns. $M^+(\theta^*)$ and $M^-(\theta^*)$ are the upward and downward truncated means (i.e. the expectations of $\theta$ conditional on $\theta$ being above or below $\theta^*$). The cutoff $\theta^*$ (or alternatively the tax $\tau(\theta^*)$ that induces $\theta^*$) is then given by

$$\theta^* - \tau + \mu[M^+(\theta^*) - M^-(\theta^*)] \equiv \theta^* - \tau + \mu\Delta(\theta^*) = 0.$$

The variation of the threshold to the discriminatory tax is no longer 1 for 1 if $\mu$>0, and is given by:

$$\frac{d\theta^*}{d\tau} = \frac{1}{1 + \mu\Delta'(\theta^*)}.$$

21. Following Bénabou and Tirole (2006, 2013), Besley et al. (2017), Chen (2017) and Jia and Persson (2017).

Let us assume that image concerns are not too large, $1+\mu\Delta'(\theta^*)>0$ , and so the equilibrium threshold is unique and $\tau(\theta^*)$ well-defined. The analysis is unchanged, except that now

$$W(\theta^*) = V(\theta^*) + R(\tau(\theta^*)) - B.$$

Introducing social pressure adds a few interesting additional insights, though. If the distribution $f(\theta)$ is unimodal, the function $\Delta(\theta^*)$ is U-shaped. When conversions are rare, the reputational concern is driven mainly by the strong stigma attached to conversions (and so $\Delta'(\theta^*)<0$). The discriminatory tax has a strong impact on the threshold because it not only provides a material incentive for conversion, but it also releases the social stigma attached to conversions. When in contrast there are few Copts remaining, reputational concerns are mainly driven by the social prestige attached to resistance (and so $\Delta'(\theta^*)>0$); the discriminatory tax impact on the threshold is then less than 1 for 1. [22]

The model can also be extended to allow for *network externalities*. Suppose that (ignoring social norms) individuals put positive weight $e_k$ (for externality) on the size of their religious community where $k$ indexes the community ($k=C$ for Copts and $k=M$ for Muslims). Then the threshold is given by:

$$\theta^* - \tau + e_C[1 - F(\theta^*)] \equiv e_M F(\theta^*).$$

Provided that the network externality parameters $e_k$ are not too large (so as to avoid equilibrium indeterminacy), $\frac{d\theta^*}{d\tau}>1$.

When individuals are affected by a social norm or a network externality as just described, the revenue function must be written as $R(\tau(\theta^*))$, where $\tau(\theta^*)$ is the inverse function. Whether the $V$ function is affected by social norm or externality considerations depends on its foundations; in the lead example, the $V$ function is unchanged if the ruler is extrinsically motivated, but not if he is intrinsically motivated. The overall analysis carries over provided that the welfare function remains quasi-concave.

(c) *Discrimination through non-price instruments.* We observed that in our model, a simple pool tax is the optimal instrument for the ruler to discriminate against an unwanted minority. In practice because such direct discrimination may be prohibited, we observe more indirect forms of discrimination, such as neighborhood-based access to public goods,

22. One can go further in the elasticity analysis by assuming that $\Delta''(\theta^*)>0$ (a hypothesis for which Jia and Persson (2017) find supporting evidence in a different context).

ethnicity-based patronage and incendiary rhetoric. Glaeser and Shleifer (2005) describe such forms of discrimination in 20th century US, staging an Irish-catholic/Anglo-Saxon-protestant conflict in Boston and a black/white conflict in Detroit. In both examples, the mayor induced over the years substantial migration of the minority out of the city, reinforcing the incumbent's political power;[23] Glaeser and Shleifer call this the "Curley effect," after the name of a Boston mayor who was in power for most of the 1913-1951 period. A direct, ethnic or race-based tax discrimination being prohibited by the federal government, the ruler's hostility toward the minority shifted to presumably less efficient forms of utility extraction. The paper also documents Robert Mugabe's tactic in Zimbabwe, which led to substantial migration by white farmers.

Our model can accommodate such non-price instruments. The Online Appendix demonstrates how for instance racial slurs and patronage can be modeled through our $V(\theta^*) + R(\theta^*)$ framework. In both illustrations the optimal policy always lies on the wrong side of the Laffer curve.

## 3.2 Optimal tax structure: basic comparative statics

The first-order condition for ruler welfare maximization is

$$V'(\theta^*) + R'(\theta^*) = 0.$$

The uniform tax is then given by $\lambda^* = B - R(\theta^*)$. The strict quasi-concavity of the welfare function implies that $\tau^* > \tau^m$ if and only if $V'(\tau^m) > 0$.[24]

*Lead example: Under extrinsic motivation*, the optimal discriminatory tax *always* lies on the wrong side of the Laffer curve: $\max_{\{\tau\}}\{(\tau - c)[1 - F(\tau)] - B\}$ yields an optimal tax exceeding the level that maximizes $\tau[1 - F(\tau)]$.[25]

23. Migration then reduces resistance to the ruler over time because of the majoritarian electoral system. By contrast, our time-decreasing resistance in Section 3.4 will be based on a reduced stake for the converts.

24. $\tau^* > \tau^m$ implies that $V'(\tau^m) + R'(\tau^m) = V'(\tau^m) > 0$, and conversely.

25. As Giacomo Ponzetto suggested to us, this intrinsic motivation modeling, properly reinterpreted, also covers the design of "sin taxes" (O'Donoghue and Rabin, 2006). Consider a hyperbolic consumer with present bias parameter $\beta$ (and otherwise no discounting). Consumption today brings immediate benefit $b$ drawn from distribution $G(b)$ in $[0, \infty)$ and fixed delayed cost $c$. Let $F(\theta) \equiv G(\theta + \beta c)$. Given a sin tax $\tau$ for consumption, the cutoff is $\theta^* = b + \beta c = \tau$. So $R(\theta^*) \equiv \theta^*[1 - F(\theta^*)]$. And paternalistic preferences can be expressed as $\int_{\tau+\beta c}^{\infty}(b-c)dG(b) = \int_{\theta^*}^{\infty}[\theta - (1-\beta)c]dG(\theta) \equiv V(\theta^*)$. The optimal cutoff, given by $(1-\beta)c = \frac{1-F(\theta^*)}{f(\theta^*)}$, lies on the wrong side of the Laffer curve. The equivalent of apostasy in this case would correspond to a permanent withdrawal: once the individual has stopped consuming, she will

By contrast, under *intrinsic motivation*, the discriminatory tax lies on the wrong side of the Laffer curve if and only if at $\tau^m$ the ruler is hostile to non-converts: Maximizing $\int_\tau^\infty \{[1-\delta(\theta)](\theta-\tau)dF(\theta) - [B-R(\tau)]\}$ yields an optimum to the right of $\tau^m$ if and only if the derivative of the first term in the maximand is positive at $\tau^m$, or $M_\delta^+(\tau^m) \equiv \frac{\int_{\tau^m}^\infty \delta(\theta)dF(\theta)}{1-F(\tau^m)} > 1$ (the ruler is hostile to non-converts).

More generally, the condition writes

$$c > [1 - M_\delta^+(\tau^m)]\tau^m.$$

Next, suppose that the uniform tax is subject to a binding cap[26] $\lambda \leq \bar{\lambda} < \lambda^*$. The cap on the uniform tax implies a floor on discriminatory tax revenue: $R(\tau) \geq B - \bar{\lambda}$. If $V'(\tau^m) > 0$, the strict quasi-concavity of the revenue and objective functions implies that the constrained optimum, $\tau^{**}$, satisfies $\tau^m \leq \tau^{**} < \tau^*$. If $V'(\tau^m) < 0$, then the reverse inequalities hold: $\tau^* < \tau^{**} \leq \tau^m$.

Finally, let us look at the impact of ruler religiosity on taxation. If ruler 1 is more religious than ruler 2 in the sense of Definition 1 (for all $\theta^*$, $V_1'(\theta^*) > V_2'(\theta^*)$), then $\tau_1^* > \tau_2^*$. If furthermore $V_2'(\tau^m) \geq 0$, $\lambda_1^* > \lambda_2^*$.[27]

**Proposition 1** ***(being on the wrong side of the Laffer curve and implications)***

*(i) The optimal discriminatory tax $\tau^*$ is on the wrong side of the Laffer curve if and only if $V'(\tau^m) > 0$. The optimal uniform tax is given by $\lambda^* = B - R(\tau^*)$.*

*(ii) Suppose that $V'(\tau^m) > 0$. Then, if initially the land tax is constrained to be lower than its optimal level, the discriminatory tax is also smaller than its optimal level in the absence of constraint on the land tax.*

*(iii) A more religious ruler on the wrong side of the Laffer curve taxes both converts and non-converts more heavily: If $V_1'(\cdot) > V_2'(\cdot)$, $\tau_1^* > \tau_2^*$ and if furthermore $V_2'(\tau^m) \geq 0$, then $\lambda_1^* > \lambda_2^*$.*

stop consuming in the future regardless of realized benefits of consumption; this is a strong assumption in this context.

26. We focus on this case rather than the case of a floor ($\lambda \geq \underline{\lambda}$) because of the empirical evidence. As we note, the transformation of the *ushr* tax into a *kharaj* enabled rulers to raise $\lambda$, which suggests that the *ushr* tax acted as a cap rather than as a floor.

27. One has $V_1'(\tau_2^*) + R'(\tau_2^*) > V_2'(\tau_2^*) + R'(\tau_2^*) = 0$. The strict quasi-concavity of the objective function then implies that $\tau_1^* > \tau_2^*$.

The results in parts (ii) and (iii) of Proposition 1 are reversed if the optimal policy lies on the right side of the Laffer curve: A cap on the land tax *increases* the discriminatory tax; and a small increase in ruler religiosity *reduces* the tax burden on converts.

*Social norms, network externalities*

**Proposition** 1′ ***(social norms, network externalities)***

(i) *The conversion rate* $F(\theta^*)$ *is invariant to the existence of a social norm (i.e., to the intensity* $\mu$ *of image concerns), as the ruler optimally augments the tax by an amount equal to the perceived image benefit of remaining Copt:*

$$\tau^* = \theta^* + \mu[M^+(\theta^*) - M^-(\theta^*)].$$

(ii) *Under network externalities, the optimal discriminatory tax satisfies*

$$\tau^* = \theta^* + [e_C[1 - F(\theta^*)] - e_M F(\theta^*)].$$

*In contrast with the case of a social norm, the cutoff is in general not invariant to the presence of network externalities:*

$$\theta^* + 2[e_C[1 - F(\theta^*)] - e_M F(\theta^*)] = c + \frac{\int_{\theta^*}^{\infty} \delta(\theta) dF(\theta)}{f(\theta^*)}.$$

The proof of Proposition 1, like other missing proofs, can be found in the online Appendix. The difference in the conclusions for social norms and network externalities comes from the impact on efficiency of moving the cutoff $\theta^*$. Image is a positional good ($F(\theta^*)M^-(\theta^*) + [1 - F(\theta^*)]M^+(\theta^*) \equiv E(\theta)$) and so altering the cutoff has no direct efficiency consequence. Furthermore passing through the image benefit ($\mu[M^+(\theta^*) - M^-(\theta^*)]$) into the discriminatory tax keeps the cutoff constant. In contrast, the overall network externality,

$$e_C[1 - F(\theta^*)]^2 + e_M[F(\theta^*)]^2$$

varies with the cutoff unless $e_C[1 - F(\theta^*)] = e_M F(\theta^*)$. Efficiency requires making the bigger group even bigger (for $e_C = e_M$, say) and so the optimal cutoff in general depends on the existence of community externalities.

*Copt religiosity*

We must here focus on the lead example, which is explicit about how $V$ depends on the distribution $F$, while the general formulation is not. Let us index religiosity in the following way. The distribution of willingnesses to remain copt is $F(\theta - r)$, and so a higher $r$ corresponds to an increase in religiosity.

**Proposition 2** ***(impact of Copt religiosity on taxation)*** *In the lead example:*

*(i) When the ruler is extrinsically motivated, an increase in Copt religiosity (a) increases the discriminatory tax, (b) lowers the conversion rate, and (c) reduces the uniform tax.*

*(ii) When the ruler is intrinsically motivated and provided that $f$ is log-concave*[28] *and that at the optimum the ruler discriminates against the marginal member of the non-convert population, a marginal increase in Copt religiosity implies an increase in the discriminatory tax.*

*Proof:*

(i) Under extrinsic motivation, the ruler solves $\max_{\{\tau\}}\{(\tau - c)[1 - F(\tau - r)]\}$ and so at the optimum $0<\frac{d\tau}{dr}<1$ (using the log-concavity of $1-F$), and so the tax increases and the conversion rate, $F(\tau - r)$ decreases with $r$. Finally, the land tax is $\lambda = B - \tau[1 - F(\tau - r)]$ and so, using the first-order condition, $\frac{d\lambda}{dr} = f(\tau - r)[c\frac{d\tau}{dr} - \tau] < 0$ as $\frac{d\tau}{dr} < 1$ and $\tau > c$.

(ii) The first-order condition is:

$$\frac{\partial W}{\partial \tau} = f(\tau^* - r)\left[-\tau^* + \int_{\tau^*}^{\infty} \delta(\theta)\frac{f(\theta - r)}{f(\tau^* - r)}d\theta\right] = 0.$$

The log-concavity of $f$, together with the fact that $\delta(\theta) > 0$ for all $\theta \geq \tau^*$ implies that the term in brackets is increasing in $r$. Thus if $\partial W(\tau^*(r), r)/\partial \tau = 0$, $\partial W(\tau^*(r), r+\varepsilon)/\partial \tau > 0$ for $\varepsilon > 0$ and small. And so $\tau^*$ must increase as $r$ increases. ■

**Remark.** *When $V$, but not $R$, depends on a parameter $\xi$ such that $\frac{\partial^2 V}{\partial \theta^* \partial \xi}>0$ and $V'(\tau^m, \xi)>0$,*[29] *then an increase in $\xi$ leads to an increase in both taxes. This is the case for instance if $\xi$ measures the ruler's religiosity or hostility. As we just saw, this positive co-variation need not hold if the parameter $\xi$ affects the revenue as well, as shown by the Copt religiosity example.*

28. From Prekova's theorem, a sufficient condition for a monotonic function taking value 0 at one of the bounds of its support to be log-concave is that its derivative is log-concave: $(f'/f)' \leq 0$.

29. Note that $\tau^m$ does not depend on $\xi$ if $R$ does not.

*Copt income*

Our comparative statics with respect to Copt income are more patchy. Suppose that agent $\theta$'s utility is the small-tax linear approximation $\theta x - \alpha(\lambda + \tau x)$ (where $x$ is 1 if the agent remains Copt and 0 otherwise). The parameter $\alpha$ is a proxy for the marginal utility of income. The cutoff is then $\theta^* = \alpha\tau$. We further assume that the function $V$ is independent of $\alpha$ (which is the case for extrinsic motivation).

The ruler's objective function, assumed strictly quasi-concave, is then: $V(\theta^*) + \tau[1 - F(\alpha\tau)] = V(\theta^*) + \frac{R(\theta^*)}{\alpha}$. This yields:[30]

**Proposition 3** ***(Copt income)*** *Suppose that preferences are $\theta x - \alpha(\lambda + \tau x)$ and that $V$ does not depend on $\alpha$.*

*(i) When the optimal discriminatory tax is on the wrong side (resp. right side) of the Laffer curve, the higher the Copts' marginal utility of income, the more (resp. fewer) conversions take place under optimal taxation.*

*(ii) If the curvature of the ruler's objective function is bounded away from 0, then as long as the discriminatory tax is not too far away from the peak of the Laffer curve, the discriminatory tax (resp. the uniform tax) decreases (resp. increases) with the Copts' marginal utility of income.*

## 3.3 Legitimacy

One obvious concern for rulers is the threat of rebellion. This concern may impact the choice of taxes. We capture the Copts' possible revolt in a simple way. We assume that a successful rebellion kicks the Muslims out of power and so taxes are no longer sent to the Caliphate. Revolting costs $\rho > 0$ to each rebel. The revolt is successful if and only if at least $1 - F(\hat{\theta})$ Copts rebel,[31] an assumption that reflects the fact that the gain from rebellion, $G(\theta)$, is weakly increasing in $\theta$ and so the most religious Copts are also the most eager to rebel:

$$G(\theta) = \begin{cases} \lambda + \theta & \text{for} \quad \theta \leq \tau \\ \lambda + \tau & \text{for} \quad \theta \geq \tau. \end{cases}$$

30. To prove (i), note that $d\theta^*/d\alpha = R'/\alpha[\alpha V'' + R'']$. To prove (ii), use $d\theta^* = \alpha d\tau + \tau d\alpha$.

31. Assuming that the success of a revolt depends only on the number of rebels ignores some other determinants of a successful rebellion, such as the homogeneity of the rebel population or its financial capability.

Assuming away coordination problems so that a rebellion indeed occurs whenever at least $1 - F(\hat{\theta})$ are willing to incur cost $\rho$ if they know the rebellion will succeed, the no-revolt constraint for the ruler is: [32]

$$G(\hat{\theta}) = \lambda + \min\{\tau, \hat{\theta}\} \leq \rho. \tag{4}$$

We are interested in situation in which the policy that would be optimal in the absence of revolt would trigger a revolt and is therefore infeasible: $\rho < \min\{\lambda^* + \hat{\theta}, \lambda^* + \tau^*\}$. To this purpose, we start from a cost level $\rho$ that creates no rebellion under the optimal policy and lower it so that the no-rebellion constraint becomes binding. We can consider two cases, depending on the level of the two taxes $\lambda^*$ and $\tau^*$ in the absence of possibility of rebellion:

(a) *Marginal rebel is a convert:* $\hat{\theta} < \tau^*$

In this case (in which the revolt must have a large scale to be successful), the no-revolt constraint, which is binding, is

$$\lambda + \hat{\theta} = \rho < \lambda^* + \hat{\theta}.$$

Thus, $\lambda$, which is the only tax paid by converts, must be decreased, which implies that, on the wrong side of the Laffer curve, the discriminatory tax must be decreased as well: $\tau < \tau^*$. The ruler lowers a tax that is not levied on the marginal rebel. By contrast, on the right side of the Laffer curve, the discriminatory tax is increased.

(b) *Marginal rebel is a non-convert:* $\hat{\theta} > \tau^*$

The no-revolt constraint, which is binding, is then

$$\lambda + \tau = \rho < \lambda^* + \tau^*.$$

Both taxes must be decreased, regardless of which side of the Laffer curve the unconstrained optimum lies. [33]

**Proposition 4** ***(revolt-constrained public finance)*** *Legitimacy always requires low-*

32. We assume that $V$ does not depend on $\rho$. Even if the ruler internalizes the agents' utility, there is no rebellion cost on the equilibrium path; and anyway the internalization does not call for allowing a rebellion.

33. Because $\rho - \tau + R(\tau) = B$, $d\tau/d\rho = 1/[1 - R'] = 1/[F + \tau f]$.

*ering the non-discriminatory tax* ($\hat{\lambda} < \lambda^*$) *when the no-revolt optimum* $(\tau^*, \lambda^*)$ *is on the wrong side of the Laffer curve, legitimacy requires lowering the discriminatory tax* ($\hat{\tau} < \tau^*$)*, even when the marginal rebel is a convert, who therefore does not pay it tax. By contrast, if the no-revolt equilibrium is on the right side of the Laffer curve, the discriminatory tax is increased if and only if the marginal rebel is a convert.*

Next, consider the following extension: Suppose that initially the land tax is bounded above at some level $\lambda \leq \bar{\lambda} < \lambda^*$. The discriminatory tax must therefore be kept at a low level so as to bring revenue. If an innovation lifts the ceiling on the land tax, then the discriminatory tax can be raised as well. This increase in both taxes broadens the set of Copts who might rebel. It also changes the composition of Copts by increasing the fraction of converts. Both effects suggest that converts are increasingly involved in rebellion as the tax on land becomes less constrained.[34] We will come back to this point as revolts initially included non-converts and later brought converts or board as well.

## 3.4 Dynamics of conversion and the land tax

Next, we extend the analysis of the basic model to a multi-period context. We assume that unwanted population exit is definitive. Jewish intellectuals who left Germany for the United States did not come back once politics in Germany returned to normal. Individuals who convert to Islam and their children cannot reassume their previous religion by fear of apostasy. Even quits in organizations are rarely reversed. Absorbing exit implies a fair amount of hysteresis of the impact of public policies. The cutoff $\theta_t^*$ must satisfy: $\theta_t^* \geq \theta_{t-1}^*$ (apostasy constraint). We investigate the dynamics of taxation and its structure assuming that the ruler cannot commit to a policy.

The poll tax $\tau_t$ is levied on Copts who have not yet converted and so keep "consuming" the Coptic religion at date $t$. One may wonder whether, once the least religious Copts have converted and the remaining Copt population is more religious than the initial one, the ruler might be tempted to raise the poll tax, with implications for the land tax.

Suppose that there are two periods, $t = 1, 2$ (the results extend to an arbitrary number of periods). The discount factor is $\beta$. The ruler faces date-$t$ budgetary need $B_t$

34. Modeling this properly requires extending the model so that revolts occur on the equilibrium path (to this purpose one can make $\hat{\theta}$ uncertain for the rulers, or introduce an idiosyncratic level of the cost of rebellion $\rho$ -which might even be negative for some Copts, who might rebel on purely adversarial grounds and not only not to pay taxes or to remain Copt.)

at date $t$.[35] The ruler cannot use capital markets to smooth the budgetary need over time, which seems a reasonable assumption in our context.

Let us first note that Copts in equilibrium behave myopically (as if $\beta = 0$):

$$\theta_t^* = \max\{\tau_t; \theta_{t-1}^*\}$$

(using the convention that $\theta_0^* = -\infty$ so that there is no constraint at date 1). This property is trivially satisfied at date 2, the last period of the game. To see that $\theta_1^* = \tau_1$, note that at date 2 the ruler will never choose a poll tax below $\theta_1^*$ and so there is no option value for the marginal type from not converting: the ruler's date-2 payoff for $\tau_2 < \theta_1^*$ is $V_2(\theta_1^*) + \tau_2[1 - F(\theta_1^*)]$ and therefore is strictly increasing in $\tau_2$. We therefore can write the ruler's date-$t$ welfare as:

$$W_t(\tau_t; \theta_{t-1}^*) = V_t(\max\{\tau_t; \theta_{t-1}^*\}) + \tau_t[1 - F(\max\{\tau_t; \theta_{t-1}^*\})] - B_t$$

and $\sum_{t=1}^{2} \beta^{t-1} W_t(\tau_t; \theta_t^*)$ is the intertemporal welfare.

A key observation is that as long as myopically optimal policies (in which both the ruler and the Copts behave as if $\beta = 0$) lead to more conversions over time, then the equilibrium of the dynamic conversion game is the sequence of myopically optimal policies.[36] Intuitively, the apostasy constraint is then non-binding. More precisely, we will consider the myopically optimal policy given by $\{\lambda_t^*, \tau_t^*\}$ where $\tau_t^* \equiv \arg\max_{\{\tau\}}\{W_t(\tau)\}$ and $\lambda_t^* = B_t - R(\tau_t^*)$.

**Proposition 5** ***(dynamics of conversion and land tax)*** *In the following cases, the outcome is the same as with myopic principal(s) and myopic agents and so the outcome* $\{\lambda_t, \tau_t\}_{t=1,2}$ *satisfies:*

*(i) If nothing changes between the two periods (stationary case), then the equilibrium involves a constant poll tax and land tax, equal to the static levels* $(\tau^*, \lambda^*)$*. All conversions occur at date 1.*

*(ii) If the budgetary need changes from date 1 to date 2* $(B_2 \neq B_1)$*, then the budget*

35. This budgetary need is taken to be deterministic, but the analysis can be extended to a random need.

36. We refer to Tirole (2016) for an analysis of games with positive selection in a general principal-agent context, including for cases in which the "apostasy constraint" is binding. We here content ourselves with stating new results.

*increase is met solely through a change in the non-discriminatory tax:* $\tau_t = \tau^*$ *for* $t \in \{1,2\}$ *(so all conversions again occur at date 1) and* $\lambda_t = \lambda_t^*$ *for* $t \in \{1,2\}$ *with* $\lambda_2^* = \lambda_1^* + (B_2 - B_1)$.

*(iii) If date-2 rulers are more pious than date-1 rulers (*$V_2'(\theta^*) > V_1'(\theta^*)$ *for all* $\theta^*$*) keeping B constant (*$B_2 = B_1$*), then a)* $\tau_2 = \tau_2^* > \tau_1 = \tau_1^*$ *there will be conversions at both dates, and b) if* $V_1'(\theta_1^*) \geq 0$*, then* $\lambda_2 = \lambda_2^* > \lambda_1 = \lambda_1^*$*: the land tax is increased at date 2. By contrast, if the date-2 rulers are less religious than the date-1 rulers, then there is ratcheting:* $\lambda_2 = \lambda_1 = \lambda_1^*$ *and* $\tau_2 = \tau_1 = \tau_1^*$*: date-2 taxes are set at the preferred levels of the date-1 rulers.*

These properties are corollaries of Proposition 1. For example, for part (iii), recall that a more religious ruler imposes a higher discriminatory tax. So the apostasy constraint is not binding as the marginal convert at date 1 knows that he would anyway strictly prefer to convert at date 2 if he does not convert at date 1.

The asymmetric responses to an increase and a decrease in the rulers' religiosity may surprise the reader. Suppose that the date-1 rulers are more religious and that they expect the date-2 rulers to keep the same fiscal policy. Then they choose their preferred policy. But will the date-2 rulers follow that policy? Because converts cannot convert back, there is no new conversion as long as the poll tax is no larger than the first-period one; while the date-2 rulers would like to have more revenue from the poll tax and fewer conversions, there is no way back. So over the date-2 rulers' preferred policy range, both the land tax and the poll tax are non-distortionary. The date-2 rulers however prefer the highest poll tax in that range, because this poll tax is paid by citizens with lower welfare weight while the land tax is paid by all. So indeed the date-2 rulers reluctantly, but optimally keep up the same policy.

*Uncertainty about Muslim rule: the option value of remaining copt*

Keeping the two-period framework, suppose that at date 1, there is probability $x$ that the Muslim rulers will be evicted and so taxes destined to the Caliphate will not be in force at date 2. Everything else is kept constant across periods. The uncertainty about the Muslim rule makes Copts more reluctant to convert as they are now losing an option value. Letting $(\lambda_2, \tau_2)$ denote the date-2 tax vector if the Muslim rule continues at date

2, the payoffs are

$$U(\theta) = \begin{cases} -\lambda_1 - \beta(1-x)\lambda_2 \text{ for a (date-1) convert} \\ -\lambda_1 + (\theta - \tau_1) + \beta\left[x\theta + (1-x)\max\{0, \theta - \tau_2\} - (1-x)\lambda_2\right] \text{ for a non-convert.} \end{cases}$$

We look for an equilibrium in which the apostasy constraint is not binding ($\theta_2^* \geq \theta_1^*$). In this case, the date-1 cutoff $\theta_1^*$ is given by:

$$(1 + \beta x)\theta_1^* = \tau_1.$$

The ruler solves[37]

$$\max_{\{\theta_1^*, \theta_2^*\}} [V(\theta_1^*) + R_1(\theta_1^*) - B] + \beta x V(\theta_1^*) + \beta(1-x)[V(\theta_2^*) + R_2(\theta_2^*) - B].$$

The revenues are

$$R_1(\theta_1^*) \equiv [(1 + \beta x)\theta_1^*][1 - F(\theta_1^*)],$$

and

$$R_2(\theta_2^*) \equiv \theta_2^*[1 - F(\theta_2^*)] = R(\theta_2^*).$$

Simple computations show that $\theta_1^* = \theta_2^* = \theta^*$: the apostasy constraint ($\theta_2^* \geq \theta_1^*$) is indeed not binding.

**Proposition 6** ***(option value under uncertain Muslim rule)*** *Under uncertainty about Muslim tenure, all conversions occur at date 1 and the magnitude of conversions is the same as in the absence of uncertainty* ($x = 0$). *In contrast, for constant budgetary needs, the land tax increases over time:* $\lambda_2 = \lambda_1 + \beta x R(\tau^*)$. *The poll tax decreases over time:* $\tau_1 = (1 + \beta x)\tau_2$.

Intuitively, the possibility that the Muslim rulers be chased out of the country creates an option value when remaining Copt. This implies that the demand for remaining Copt is more inelastic at date 1 and so the rulers can collect a fair amount of money from the poll tax. This explains the opposite dynamics of the poll and land tax revenues.

*The dynamics of rebellion: time-decreasing resistance*

37. We write the program as if the rulers committed at date-1 to their date-2 policy conditionally on staying in power. But it is easy to check that the outcome is the same in the absence of commitment over $(\lambda_2, \tau_2)$.

Finally, let us look at the dynamic generalization of the legitimacy model developed in the previous section: It takes $[1 - F(\hat{\theta})]$ rebels to topple the Muslim rule, and the individual cost of doing so is $\rho$.

A key insight is that the incentive to rebel decreases over time, as depicted in Figure 1. Earlier converts' gain from a successful rebellion is limited to the uniform tax and no longer includes the preservation of their foregone identity. As Proposition 7 below shows, this implies that the ruler may raise taxes over time in an otherwise fully stationary economy. Assume for expositional conciseness that agents are myopic ($\beta = 0$); for instance, each generation cares about its own welfare, but apostasy implies that conversions apply to future generations. We further focus on the case in which the discriminatory tax lies on the wrong side of the Laffer curve in the static environment. While specific results hinge on these assumptions, the point that resistance decreases over time is fully general.

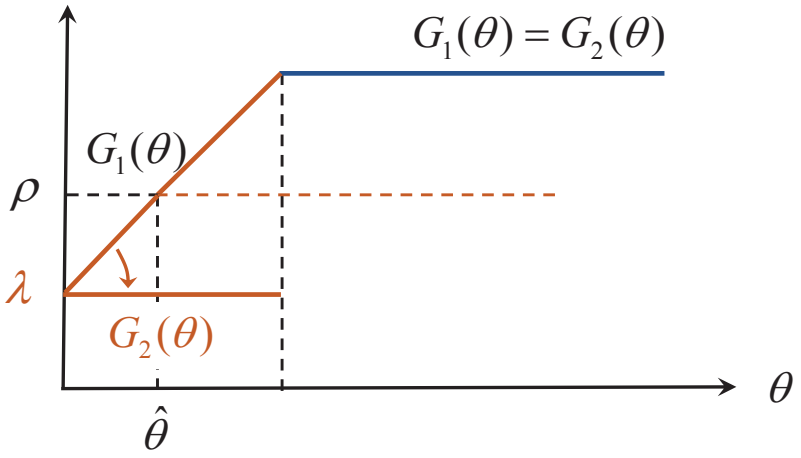



Figure 1 – $G_t(\theta)$ = **date-$t$ gain from a successful rebellion at date $t$.**

**Proposition 7** ***(conversions weaken resistance over time)*** *Assume that agents are myopic, that the optimal static tax $\hat{\tau}$ lies on the wrong side of the Laffer curve in the static model and that $\rho < \lambda^* + \tau^*$ (otherwise there would not be a threat of rebellion).*

*(i) Suppose that in the static analysis the marginal rebel is a convert. The no-rebellion constraint becomes looser over time, as converts have less to gain from a rebellion than non-converts. Both taxes increase between the two dates as the resistance of converts is weaker than that of non-converts. There are new conversions at date 2. In particular, if the rebellion cost $\rho$ belongs to $(\lambda^*, \lambda^* + \tau^*]$, the date-1 taxes are $(\lambda_1, \tau_1) = (\hat{\lambda}, \hat{\tau})$ and the date-2 taxes are $(\lambda_2, \tau_2) = (\lambda^*, \tau^*)$.*

*(ii) If the marginal rebel in the static analysis is a non-convert, the no-rebellion constraint is equally binding in the two periods and taxes are constant over time. All conversions occur at date 1.*

**Remark** As we earlier noted, the absence of uncertainty precludes the existence of actual (on-the-equilibrium-path) revolts. Introducing some uncertainty about the value of $\rho$ or $\hat{\theta}$ in general leads to a positive probability of an on-the-equilibrium-path revolt. While a full treatment of this lies outside the scope of this paper, a few interesting points can be made. First, while the converts' willingness to revolt is reduced by their inability to convert back, their goals become more aligned: their incentive to rebel comes from economizing the uniform tax, and their heterogeneity in religiosity is no longer relevant; so the converts rebel en masse if they rebel at all. Second, at date 1, all potential rebels are Copts; at date 2, some of the rebels may well be Muslims as well.

*Costly reform of tax institutions*

Finally, recall that the Egyptian tax system was initially constrained by a cap on the uniform tax (the land tax levied on Muslims- the *ushr*-, unlike the *kharaj*, was set exogenously: the Prophet had set it at a fixed 10% rate). The reform removing this constraint happened only about a century after the invasion, when rulers changed the tax system so as to be able to levy the *kharaj* on converts. Why did the rulers not give themselves more degrees of freedom right away? The following corollary offers a possible explanation for the delay. This explanation will not require the introduction of a fixed cost of reforming the tax system to eliminate this constraint, even though the existence of such a cost is reasonable as going against the Prophet's recommendation was presumably costly.

**Corollary 1** ***(delayed tax-system reforms due to time-decreasing resistance)*** *Because the threat of rebellion constrains the uniform tax and this threat is reduced over time as the benefit from rebelling decreases with conversion, a cap on the uniform tax may not initially constrain optimal taxation, but do so later on. Hence tax reforms may be delayed even if the cost of modifying the tax system is small.*

# 4 Empirics

The empirical evidence on the predictions of the model comes from Egypt, where the vast majority of tax papyri under the early Arab Caliphate were discovered. We first

specify the testable predictions of the model. We then present the local-level evidence, where we exploit the geographic variation within Egypt in tax rates and conversions. Next, we discuss the country-level evidence, where we document the evolution in 641-850 of (proxies for) the determinants of the uniform tax rate increase circa 750 in Egypt, noting that similar evolutions may have occurred elsewhere since the 750 tax reform was enforced throughout the whole Caliphate. Both pieces of evidence are broadly consistent with the predictions of the model. However, given the data limitations, our findings remain suggestive and their interpretation rests on theory and history.

## 4.1 Empirical predictions of the model

Table 1 lists the empirical predictions of the model under the assumption that tax authorities are sufficiently religious so that the optimal discriminatory tax lies on the wrong side of the Laffer curve (it indicates whether results change under the opposite assumption). Holding everything else constant, more religious tax authorities are expected to levy higher discriminatory and uniform taxes and to induce more conversions to Islam among Copts. An increase in budgetary needs is met by increasing the uniform tax but should have no impact on the discriminatory tax rate and conversions. By contrast, an increase in uncertainty about Muslim rule, by making the demand for Coptic Christianity less elastic, results in increasing the discriminatory tax rate and decreasing the uniform tax but should leave conversions unaffected. If tax authorities are driven solely by extrinsic motivation, more religious Coptic taxpaying populations face a higher discriminatory tax rate and witness fewer conversions to Islam, but the effect on the uniform tax is ambiguous. However, if tax authorities are driven by intrinsic motivation, an increase in Copt religiosity increases the discriminatory tax only under additional assumptions, and has ambiguous effects on the uniform tax and conversions. A taxpaying population that poses a higher threat of rebellion is expected to face lower discriminatory and uniform tax rates and to witness fewer conversions to Islam. We expect poorer Coptic populations (who presumably have a higher marginal utility of income) to witness more conversions. Furthermore, if the optimal discriminatory tax is in the neighborhood of the peak of the Laffer curve, they face a lower discriminatory tax rate and a higher uniform tax rate. Finally, we predict that if there is a cap on the uniform tax, both the uniform and discriminatory taxes will be lower and there will be fewer conversions.

If the optimal discriminatory tax lies on the right side of the Laffer curve, certain predictions may be reversed, though. The first key observation here is that more religious tax authorities will levy a *lower* uniform tax. Second, more rebellious populations will face a *higher* discriminatory tax and will witness *more* conversions, if the marginal rebel is a convert (but the effects will *not* be reversed if the marginal rebel is a non-convert). Third, poorer Copts with a higher marginal utility of income will witness *fewer* conversions. Finally, a cap on the uniform tax will result in a *higher*, not lower, discriminatory tax and thus *more* conversions.

Overall, we have provided four possible reasons for why the land tax, but not necessarily the poll tax, may increase over time: a) the budgetary need increase is absorbed by the non-distortionary land tax; b) the Muslim rulers may become more religious over time (by contrast, the land tax remains constant if the Muslim rulers become less religious over time, an asymmetric response); c) there is some possibility that the Muslim rulers be chased out of the country; d) the threat of rebellion weakens over time as past converts, while still economizing on the land tax when the rebellion succeeds, no longer benefit from being able to remain Copt (they have lower incentives to participate in a rebellion).

## 4.2 Local-level evidence

The local-level evidence exploits the cross-*kura* variation in tax rates and conversions. We focus on the effects on taxation and conversions of three exogenous parameters in the model: (1) religiosity of tax authorities, (2) Copts' religiosity, and (3) Copts' marginal utility of income. We are not able though to provide local-level evidence on the effects of four further parameters: (4) budgetary needs, (5) uncertainty about Muslim rule, (6) threat of rebellion, and (7) cap on uniform tax, because these factors, we argue, are unlikely to vary locally. First, the budgetary need of Egypt was decided by the central government in its capital, *Fustat* (currently, south of Cairo), in order to pay the tribute to the Caliphate, and to finance the salaries of Egypt's top officials, the army, the police, the judiciary, and the bureaucracy. Egypt's total required budget was then distributed across *kuras* depending on their population sizes. Therefore, while the budget need probably varied across years due to macro-level shocks in financial needs at the level of the Caliphate or Egypt that impacted all *kuras*, it was less likely to vary across *kuras*, since

Table 1 – **Empirical predictions of the model when on wrong side of Laffer curve**
Light shaded cell means that the result is reversed if on right side of Laffer curve
Dark shaded cell means that the result may be reversed if on right side of Laffer curve
N/A means that we are not able to test this prediction empirically due to insufficient data availability

| **Regressors** | Religiosity of tax authorities ($V'$) | Budget ($B$) | Uncertainty about Muslim rule ($x$) | Copts' religiosity ($r$) | Threat of rebellion[†] | Copts' marginal utility of income ($\alpha$) [††††] | Cap on uniform tax ($\lambda \leq \bar{\lambda}$) |
|---|---|---|---|---|---|---|---|
| Effect on discriminatory tax ($\tau^*$) | + | 0 | + | +[††] | − | − | − |
| Effect on uniform tax ($\lambda^*$) | + | + | − | ? | − | + | − |
| Effect on % converts ($F(\theta^*)$) | + | 0 | 0 | −[†††] | − | + | − |
| Local-level proxies | Arab settlement | N/A | N/A | Holy Family visit | N/A | (−) Urban population | N/A |
| Country-level proxies | 1. Caliph does not hold palace music and drinking parties<br>2. Standardized # religious buildings<br>− standardized # secular buildings | Battles initiated by Caliphate | 1. Attacks by neighboring empires<br>2. Caliphate's major civil wars<br>3. Nile shocks | N/A | 1. Attacks by neighboring empires<br>2. Caliphate's major civil wars<br>3. Nile shocks | Nile shocks | Pre-750 period |

Source: See text.
Notes:

† For the threat of rebellion, the impact on $\tau^*$ and $F(\theta^*)$ is reversed only if the marginal rebel is a convert.

†† In lead example, for extrinsic motivation; or in the case of intrinsic motivation, when $f$ is log-concave and at the peak of the Laffer curve the ruler discriminates against the marginal member of the non-convert population.

††† In lead example, when the ruler is driven solely by extrinsic motivation.

†††† Under restrictive assumptions (small-tax linear approximation and $V$ independent of marginal utility of income). For the effect on $\tau^*$ and $\lambda^*$, assume further that optimum is in the neighborhood of the peak of the Laffer curve.

it did not depend on the local financial needs of the inhabitants of each *kura*. Second, as the Nile Valley and Delta lacked natural barriers, all *kuras* were subject to Arabs' central authority in *Fustat*, and hence they likely faced the same level of uncertainty about Arabs' staying in power. The main exceptions here are frontier towns that switched hands between empires, such as Aswan at the southern border that was under the threat of the Nubians, and Alexandria that was retaken by the Byzantines in 645 before it was reoccupied by Arabs. These towns are *not* included in the empirical analysis, though. Third, even though local Coptic elites of a given *kura* may have resisted Arabs passively via adopting a more lenient tax policy with Coptic taxpayers in their constituencies, they were not able to pose a threat of active (militant) rebellion that could drive Arabs out of power, unless they coordinated with Coptic elites in other *kuras*. Indeed, all tax revolts that did take place in Egypt involved multiple *kuras*. Fourth, the cap on the uniform tax, *ushr*, was imposed universally on all *kuras*, and in fact throughout the whole Caliphate, taking into consideration that certain historians argue that the *ushr* was not enforced by the state until the late eighth century (see section 2).

### 4.2.1 Data

**Religiosity of tax authorities** We proxy for the religiosity of local tax authorities by a dummy variable that takes value 1 if at least one Arab tribe settled in a *kura* between 700 and 969 based on Al-Barri (1992). Arab settlement arguably captures the degree of penetration of Arabs (Muslims) into the local tax administration of each *kura*. In *kuras* where Arabs settled, they replaced local Coptic elites as large landholders and tax administrators (Sijpesteijn, 2009). Consequently, these *kuras* faced more religious tax authorities, at the *extensive* margin, compared to *kuras* where Arabs did not settle and Coptic elites thus remained in charge of the tax administration. However, we do not have a measure of religiosity among Arab tax administrators, i.e. at the *intensive* margin.[38]

**Copt religiosity** We proxy for Copt religiosity before 641 by a dummy variable that takes value 1 if it is believed, according to Coptic traditions, that a *kura* (or village, depending on the empirical specification) has been visited by the Holy Family during

38. We are not able to use the standardized difference between the number of religious and secular buildings (as in Chaney (2013)) as a measure of religiosity of tax authorities at the local level, because data on religious and secular buildings are *not* representative of *kuras* outside Cairo. Chaney (2013) uses this dataset at the country level.

its legendary flight to Egypt. The list of villages that lie on this legendary route is recorded in Anba-Bishoy (1999) and Gabra (2001); both sources are based on a book that is attributed to Theophilus, the patriarch of Alexandria in 384-412 (Mingana, 1931). However, since the book's date is debated with some scholars dating it to the post-641 period, this variable must be interpreted with caution.

**Copt income** We proxy for Copt income before 641 by the natural logarithm of the size of urban population circa 300 based on Wilson (2011, pp. 185-187). Urban population is defined as the sum of the population of Greek cities (metropolis) and the capital of each *nome* (Egypt's administrative units in the Roman period). Using urbanization as a proxy for income is standard in the economic history literature, since urban populations were richer on average.

**Taxes** Data on poll and *kharaj* land tax payments (in dinars) per person come from Egypt's papyrological individual-level tax registers and receipts in 641-1100. We employ Morimoto (1981, pp. 67-79, 85-87) for Greek papyri and the Arabic Papyrology Database for Arabic papyri.[39] Tax papyri are subject to a few caveats, though: (1) The poll (and *kharaj*) tax records survived in only 4 (respectively 7) out of 42 *kuras*, all located in the Nile Valley. (2) Most papyri are dated within a range (e.g. 641-1000), and so it is not possible to distinguish tax rates in 641-750 from the post-750 period. (3) There are no data on the *ushr* land tax rate. (4) *Kharaj* land tax payments are per person and not per unit of land (landholding surface area is seldom recorded), and hence, using these records in the analysis relies on the assumption that *kuras* had the same landholding size distribution. While there is little that we can do to address (1) and (2), we note that the other outcome variable, conversions, is observed for all 42 *kuras*. Regarding (3), the lack of any papyrological evidence on the *ushr* tax in 641-750 may indicate that the tax was not enforced by the state, and may have thus been equal to zero in all *kuras*. To address (4), we collected village-level data in the Nile Valley on *kharaj* per unit of land from the cadastral surveys of 1375 and 1477 that were conducted under the Mamluk dynasty (1250-1517) and recorded by Ibn-Al-Jay'an (1477). These are the earliest extant

39. We do not employ two other sets of tax papyri. First, there are other Coptic and Greek poll tax registers and receipts from Egypt in 641-800 that we do not use because they have not been digitized yet. Second, there are poll tax receipts from Nessana in Palestine (Simonsen, 1988) that we do not use because they do not vary within Palestine (they come from only one area).

cadasters that report *kharaj* per unit of land.[40] Specifically, they record for each village the *'ibra* in *jayshi* dinars per *feddan*, where the *'ibra* is the average *kharaj* tax over 15-20 years, and the *jayshi* dinar is a hypothetical unit of account that is approximately equal to 13.3/20 dinars (Borsch, 2005). Despite the appeal of using the *kharaj* tax per unit of land in 1375 and 1477 as our preferred measure of *kharaj*, it is subject to a perhaps more serious caveat in that it comes from the Mamluk period, a much later period than the early Arab Caliphate. Mamluk tax administration was fundamentally different from the early Arab Caliphate in that Egypt became subject to a tax contracting system (*'iqta'*) with Turkish military officers (Mamluks), not Arabs, being in charge of tax collection in their constituencies. We thus prefer to use *kharaj* per person in 641-1100 as our preferred measure and we only employ *kharaj* per unit of land in 1375 and 1477 only as a robustness check.

**Conversions** We proxy for conversions at the village level by an indicator variable that takes value 1 if a village had at least one Coptic church or monastery circa 1200 from Abul-Makarim (1200). As a robustness check, we complement this data source with a later list of Coptic churches and monasteries circa 1500 from Al-Maqrizi (1500).

### 4.2.2 Empirical strategy

Using these novel data sources, we first examine the effects on tax rates and conversions of our local-level proxies of religiosity of tax authorities, Copts' religiosity, and Copts' marginal utility of income. We estimate a separate regression for each outcome rather than a system of simultaneous equations that allows for correlation of the error terms across equations, because each equation is estimated using a different sample. We first treat our regressors as exogenous and estimate the following regression equations using Ordinary Least Squares (OLS):

$$polltax_{ik} = \beta_{10} + \beta_{11} settlement_k + \beta_{12} holyfamily_k + \beta_{13} urban_k + \epsilon_{1ik} \quad (5)$$

$$kharajtax_{ik} = \beta_{20} + \beta_{21} settlement_k + \beta_{22} holyfamily_k + \beta_{23} urban_k + \epsilon_{2ik} \quad (6)$$

40. Al-Nabulusi reports village-level data for the *kura* of *Fayyum* during the Ayyubid period (1171-1250) on total *kharaj* revenues, among a whole set of miscellaneous taxes, but he does *not* record total area of landholdings, and so it is not possible to compute *kharaj* per unit of land (Cahen, 1956).

$$church_{vk} = \beta_{30} + \beta_{31} settlement_k + \beta_{32} holyfamily_v + \beta_{33} urban_k + \epsilon_{3vk} \quad (7)$$

where the dependent variable in equation (5), $polltax_{ik}$, is the poll tax payment in dinars made by individual $i$ in *kura* $k$ in 641-1100. Similarly, the dependent variable in equation (6), $kharajtax_{ik}$, is the *kharaj* tax payment in dinars made by individual $i$ in *kura* $k$ in 641-1100. The dependent variable in equation (7), $church_{vk}$, is a dummy variable that takes value 1 if there was at least one Coptic church or monastery circa 1200 in village $v$ in *kura* $k$. As a robustness check, we use the *'ibra* (average *kharaj*) in *jayshi* dinars per *feddan* in village $v$ in *kura* $k$ in 1375 and 1477, as an alternative measure of the *kharaj* tax in equation (6). And as another robustness check, we use a village-level dummy variable that takes value 1 if there was at least one Coptic church or monastery circa 1500, as an alternative measure of conversions in equation (7), since the list of Coptic churches and monasteries in 1200 might be measured with error.

There are three regressors of interest. First, $settlement_k$ is a dummy variable that takes value 1 if there was at least one Arab tribe that settled in *kura* $k$ between 700 and 969. Second, $holyfamily_k$ (respectively, $holyfamily_v$) is a dummy variable that takes value 1 if *kura* $k$ (respectively, village $v$) is believed to have been visited by the Holy Family during its legendary flight to Egypt. Third, $urban_k$ is the natural logarithm of the urban population of *kura* $k$ circa 300.

Standard errors are clustered at the *kura* level, the level at which we observe the three regressors (except for the Holy Family indicator variable in equation (7) which is observed at the (lower) village level). Technically, this is a justifiable level of clustering because it is the level at which the treatments are assigned (Abadie et al., 2017). However, since the number of *kuras* (clusters) where the poll and *kharaj* tax papyri survived is extremely small, this may bias the standard errors downwards in equations (5) and (6) (Cameron et al., 2008; Cameron and Miller, 2015). The problem of "few clusters" is less of a concern though in equation (7) since we observe the outcome (churches) in all 42 *kuras*. Unfortunately, we are not able to correct for the few clusters bias in equations (5) and (6) by the adjustments that are suggested in the literature, because the regressors do *not* vary among taxpayers within clusters (*kuras*). But in order to understand the size of the (downward) bias, we also report alternative standard errors: White-Huber robust standard errors in equations (5) and (6), and robust standard errors clustered at the lower

district level (thus, more clusters) in equation (7). As predicted by the literature, these alternative standard errors are mostly larger than the ones clustered at the *kura* level (thus the latter are indeed biased downwards), but in most cases the coefficients retain their statistical significance.

The identification assumption in these OLS regressions is that the cross-*kura* variation in Arab settlement, Holy Family legendary visit, and urban population circa 300 is exogenous to any other underlying factors that may be driving taxation and conversions. This assumption may be violated due to (1) reverse causality: these regressors may have been impacted by Arab taxation and conversions, and (2) omitted variables: the regressors may be correlated with other unobservable pre-641 characteristics of *kuras* that can also account for the variation in tax rates and conversions. We argue that these threats to identification are less likely to arise for the Holy Family legendary route and urban population circa 300. For one, reverse causality is not possible since both variables are observed before 641. For another, both variables were determined by factors that are unlikely to have impacted the Arab fiscal policy and conversions in the post-641 period. The invention of the Holy Family legendary route reflected the religious prominence of certain locations due to their local saints and martyrs and/or their biblical mentions. In a similar vein, the locations and population sizes of capitals of *nomes* and Greek cities *metropolis* during the Roman period were to a large extent randomly picked along the Nile river, regardless of the characteristics of the local populations or the distance to Alexandria, Egypt's capital before 641. We acknowledge that the Holy Family route may have been invented after 641, but this is not a threat to identification per se; it is rather a measurement concern that undermines employing this variable as a measure of pre-641 Coptic religiosity in the analysis altogether. However, this variable is, despite its caveats, the only measure that we are aware of in the historical literature that can capture Copts' religiosity at the local level.

By contrast, Arab settlement in 700-969 is potentially endogenous. On the one hand, there can be reverse causality from taxation and conversions to the subsequent waves of Arab settlement. On the other hand, Arab tribes may have settled in certain *kuras* based on other unobservable characteristics (e.g. availability of grazing land) that may have also affected taxation and conversions. To mitigate this concern, we use an instrumental variable (IV) for Arab settlement: the *kura*'s distance to *Arish*, a town close to Egypt's

northeastern borders that was the first to be captured by Arabs in 639 due to its proximity to the Arab peninsula. The argument is that Arabs were more likely to settle in *kuras* that were closer to *Arish*. Distance to *Arish* is exogenous and arguably satisfies the exclusion restriction, since the proximity to *Arish*, a small border town, is unlikely to be correlated with other characteristics of *kuras*, apart from Arab settlement, that may be affecting taxation and conversions. Indeed, Table 2 indicates that distance to *Arish* is uncorrelated with our proxies of Copts' income and religiosity, and two proxies of the power of local elites and the presence of Byzantine garrisons in the late Byzantine period. [41]

Table 2 – **Exogeneity of distance to *Arish***

| | (1) Log (urban population) in 300 | (2) =1 if *kura* on Holy Family route in 400 | (3) =1 if *Autopract* estates in *kura* in 600 | (4) =1 if Byzantine garrison in *kura* in 600 |
|---|---|---|---|---|
| *Kura*'s Distance to *Arish* (km) | 0.0011 | 0.0011 | -0.0010 | 0.0004 |
| | (0.0008) | (0.0008) | (0.0007) | (0.0006) |
| Obs (*kuras*) | 42 | 42 | 21 | 42 |
| $R^2$ | 0.049 | 0.049 | 0.098 | 0.013 |

Notes: Standard errors are in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. A constant term is included in all regressions.
Source: See text.

### 4.2.3 Findings

**Discriminatory tax** The results on the determinants of the poll tax payment per person in 641-1100 are shown in Panel (3a) of Table 3. Within the four *kuras* for which we have poll tax papyri, taxpayers in *kuras* where Arabs settled in 700-969, and were thus subject to more religious tax authorities, paid on average a higher poll tax in 641-1100 by 0.29 dinar (25% of the average poll tax, 1.14 dinar). Taxpayers in *kuras* that lied on the legendary route of the Holy Family, and thus had more religious Coptic populations, paid 25% more of the average poll tax obligation. Taxpayers in more urbanized *kuras* (measured during the Roman period) also paid a higher poll tax by 0.13 dinar (11% of the

41. These are (1) a dummy variable that takes value 1 if there was at least one *autopract* estate in 600 from Hardy (1931); the *autopragia* status was a privilege granted to large landholders in late Byzantine Egypt allowing them to collect taxes in their constituencies, and (2) a dummy variable that takes value 1 if there was at least one Byzantine garrison in 600 from Maspero (1912).

average poll tax). The results hold qualitatively when including the three determinants in the same regression (column (4)), but whereas the coefficients on the Holy Family route and urbanization have much smaller magnitudes than when entered separately, the coefficient on Arab settlement retains its magnitude. The IV estimate of the effect of Arab settlement on the poll tax rate is similar in magnitude to the OLS estimate, and the first-stage regression suggests that Arabs were indeed more likely to settle in *kuras* that were closer to *Arish*. However, distance to *Arish* does not strongly predict Arab settlement ($F$-statistic <10). We interpret the positive coefficients on Arab settlement and the legendary route of the Holy Family as consistent with the predictions of the model as specified in Table 1. The theory is indeterminate though with respect to the effect of Copts' income on the discriminatory tax and thus the finding of a positive coefficient on urbanization does not confirm or infirm the model predictions.

**Uniform tax** The results on the determinants of the *kharaj* tax per person in 641-1100 are shown in Panel (3b) of Table 3. These results must be interpreted with caution since the *kharaj* tax is measured per person and not per unit of land. Thus, any effects are due to the cross-*kura* variation in both the tax rate per unit of land *and* the landholding size distribution. Assuming that the landholdings distribution is constant across the 7 *kuras* for which we have data on *kharaj*, we find that taxpayers in *kuras* that received Arab tribes in 700-969 paid a higher *kharaj* tax by 2.9 dinars (107% of the average *kharaj* tax = 2.69 dinars). We interpret this result as consistent with the prediction of the model on the impact of religiosity of tax authorities, if the optimal discriminatory tax was on the wrong side of the Laffer curve. The results also reveal that taxpayers in *kuras* on the Holy Family route paid 3.32 dinars more in *kharaj* tax (123% of the average poll tax), and that *kuras* that were more urbanized paid a higher *kharaj* tax. However, the theory is indeterminate with respect to these two effects (unless we impose further assumptions), and so we do not interpret the results on Copts' income and religiosity as confirming or infirming the model predictions. When we include all determinants in the same regression in column (4), only the coefficient on the Holy Family route retains its magnitude and statistical significance. Using distance to *Arish* as an IV for Arab settlement yields qualitatively similar results as the OLS estimate, but the IV is again a weak predictor of settlement as in Table 3a. Finally, we note that if the dependent

Table 3 – **Religiosity of tax authorities and tax rates in 641-1100**
*Dependent variable: Poll tax in dinars per person - Individual-level regressions*

(a) Dependent variable: Poll tax in dinars per person

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | 0.290 | | | 0.214 | 0.285 |
| | (0.004)*** | | | (0.000)*** | (0.005)*** |
| | {0.133}** | | | {0.960} | {0.123}** |
| =1 if *kura* on Holy Family route | | 0.285 | | 0.007 | |
| | | (0.010)*** | | (0.000)*** | |
| | | {0.139}** | | {0.346} | |
| Log (urban population) in *kura* circa 300 | | | 0.131 | 0.032 | |
| | | | (0.003)*** | (0.000)*** | |
| | | | {0.062}** | {0.515} | |
| Obs (individuals) | 408 | 408 | 408 | 408 | 408 |
| Clusters (*kuras*) | 4 | 4 | 4 | 4 | 4 |
| $R^2$ | 0.010 | 0.009 | 0.010 | 0.010 | |
| KP Wald F-stat | | | | | (8.532) |
| | | | | | {190.839} |
| Mean dependent variable | 1.136 | 1.136 | 1.136 | 1.136 | 1.136 |
| SD dependent variable | 1.236 | 1.236 | 1.236 | 1.236 | 1.236 |

(b) Dependent variable: *Kharaj* tax in dinars per person

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | 2.893 | | | -1.201 | 1.945 |
| | (0.617)*** | | | (1.967) | (1.197)+ |
| | {0.900}*** | | | {1.316} | {0.754}*** |
| =1 if *kura* on Holy Family route | | 3.320 | | 3.248 | |
| | | (0.148)*** | | (0.633)*** | |
| | | {1.010}*** | | {1.065}*** | |
| Log (urban population) in *kura* circa 300 | | | 1.357 | 0.563 | |
| | | | (0.195)*** | (1.129) | |
| | | | {0.419}*** | {0.731} | |
| Obs (individuals) | 464 | 464 | 464 | 464 | 464 |
| Clusters (*kuras*) | 7 | 7 | 7 | 7 | 7 |
| $R^2$ | 0.047 | 0.057 | 0.051 | 0.058 | |
| KP Wald F-stat | | | | | (3.783) |
| | | | | | {24.095} |
| Mean dependent variable | 2.690 | 2.690 | 2.690 | 2.690 | 2.690 |
| SD dependent variable | 6.076 | 6.076 | 6.076 | 6.076 | 6.076 |

Notes: Robust standard errors clustered at the *kura* level are in parentheses. White-Huber robust standard errors are in curly brackets. + $p$ <0.15, * $p$ <0.10, ** $p$ <0.05, *** $p$ <0.01. A constant is included in all regressions. The coefficient on *kura*'s distance to *Arish* in the first-stage regression of the Arab settlement dummy variable is − 0.009 (0.003)*** {0.001}*** for the poll tax and − 0.006 (0.003)*** {0.001}*** for the *kharaj* tax (*kura*-level clustered standard errors in parentheses, White-Huber standard errors in curly brackets). KP Wald F-Stat in parentheses corresponds to clustering standard errors at the *kura* level in the first stage, and in curly brackets to White-Huber standard errors.
Source: Individual-level poll and *kharaj* tax payments in 641-1100 from Greek and Arabic papyri in Morimoto (1981, pp. 67-79, 85-87) and the Arabic Papyrology Database. Sample is restricted to tax payments in papyri with a known *kura*.

variable captures the cross-*kura* variation in the landholdings distribution, rather than the tax rate per unit of land, it will serve as a proxy for wealth of landholders. Hence, the results suggest that richer *kuras* were more likely to attract Arab settlers, to lie on the Holy Family legendary route, and to have a larger urban population circa 300. In order to exclude this interpretation, it is important to employ our alternative measure of the *kharaj* per unit of land in 1375 and 1477. We come back to this point in the robustness checks section.

Table 4 – **Determinants of conversions in 1200**
*Dependent variable = 1 if at least one Coptic church or monastery in village*

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | -0.082 | | | -0.077 | -0.695 |
| | (0.033)** | | | (0.033)** | (2.098) |
| | {0.031}** | | | {0.032}** | {1.672} |
| =1 if village on Holy Family route | | 0.597 | | 0.600 | |
| | | (0.081)*** | | (0.080)*** | |
| | | {0.075}*** | | {0.078}*** | |
| Log (urban population) in *kura* circa 300 | | | -0.022 | -0.016 | |
| | | | (0.026) | (0.029) | |
| | | | {0.028} | {0.029} | |
| Obs (villages) | 1817 | 1817 | 1817 | 1817 | 1817 |
| Clusters (*kuras*) | 42 | 42 | 42 | 42 | 42 |
| Clusters (districts) | 75 | 75 | 75 | 75 | 75 |
| $R^2$ | 0.009 | 0.034 | 0.001 | 0.044 | |
| KP Wald F-stat | | | | | (0.083) |
| | | | | | {0.155} |
| Mean dependent variable | 0.161 | 0.161 | 0.161 | 0.161 | 0.161 |
| SD dependent variable | 0.368 | 0.368 | 0.368 | 0.368 | 0.368 |

Notes: Robust standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets. * $p$ <0.10, ** $p$ <0.05, *** $p$ <0.01. A constant is included in all regressions. The coefficient on *kura*'s distance to *Arish* in the first-stage regression of the Arab settlement dummy variable is − 0.000 (0.001) {0.001} (standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets). KP Wald F-Stat in parentheses corresponds to clustering standard errors at the *kura* level in the first stage, and in curly brackets to clustering at the district level.
Source: See text.

**Conversions** Table 4 shows the results on the determinants of conversions in 1200. Villages located in *kuras* that received Arab tribes in 700-969, and were thus subject to more religious tax authorities, are less likely to have at least one Coptic church or monastery in 1200 by 8 percentage points (average = 0.16), compared to *kuras* where Coptic elites remained in power. Since all *kuras* were (almost) 100 percent Coptic before

641, the finding suggests that *kuras* where Arab tribes settled witnessed relatively more conversions to Islam among Copts between 641 and 1200. Villages located in *kuras* that lied on the Holy Family route were more likely to have at least one Coptic church or monastery in 1200, i.e. witnessed relatively fewer conversions to Islam. But the effect of urbanization on conversions is not statistically significant. Including all regressors in the same equation in column (4) yields similar results. Using distance to *Arish* as an IV for Arab settlement in column (5) results in an imprecise estimate due to the low predictive power of the IV in the first-stage regression. We interpret the positive effect of Arab settlement on conversions as consistent with the model. The theory is indeterminate, however, with respect to the effect of Copts' religiosity on conversions and so our finding of a positive coefficient neither confirms nor infirms the model. Finally, while the theory predicts a negative effect of Copts' income on conversions if on the wrong side of Laffer curve, we fail to find supportive evidence of this prediction.

**Summary** The local-level evidence is broadly consistent with the predictions of the model. Religiosity of tax authorities, as captured by Arab settlement in 700-969, has positive and statistically significant effects on poll tax rate and conversions, as predicted by the model. More importantly, its positive effect on the *kharaj* tax rate is consistent with the optimal discriminatory tax being on the wrong side of the Laffer curve. Also, as predicted by the model, we find that Copts' religiosity, measured by the legendary route of the Holy Family, has a positive and statistically significant impact on the poll tax rate. However, the effect of Copts' income, measured by urbanization during the Roman period, on conversions is positive and statistically insignificant (the theory predicts a negative effect if on the wrong side of the Laffer curve). Finally, the theory is indeterminate with respect to (a) the effects of Copts' religiosity on the *kharaj* tax and conversions, and (b) the effects of Copts' income on the poll and *kharaj* tax rates, and hence our empirical findings on these effects do not confirm or infirm the model predictions.

### 4.2.4 Robustness Checks

In this section, we conduct two robustness checks. First, we use *kharaj* per unit of land in 1375 and 1477 as an alternative measure of *kharaj*. Second, since the list of Coptic churches and monasteries in 1200 may be measured with error, we use an alternative list

circa 1500 that has been compiled from an independent source. In order to save space, we relegate the results to the Online Appendix.

***Kharaj* per unit of land in 1375 and 1477** Table C.1 shows the results on the determinants of *kharaj* per *feddan* in 1375 and 1477. In order to have comparable results to the papyrological evidence on *kharaj* in 641-1100, where all *kuras* on which we have data are in the Nile Valley, we restrict the analysis to the Nile Valley. Consistent with our findings in Table **??**, we document that villages located in *kuras* where Arabs settled in 700-969 faced higher *kharaj* per *feddan* in 1375 and 1477. However, the impact of being located on the Holy Family route does not have a statistically significant effect on *kharaj*, whereas the impact of urbanization is now positive and statistically significant. Including all regressors in column (4) yields qualitatively similar results with the coefficient on Arab settlement retaining its magnitude and statistical significance. The IV estimate of the impact of Arab settlement is larger than the OLS estimate.

**Conversions in 1500** We use Coptic churches and monasteries circa 1500 as an alternative measure of conversions. The results, shown in Table C.2, are qualitatively similar to the results in 1200, which suggests that the cross-*kura* variation in conversions persisted between 1200 and 1500.

## 4.3 Country-level evidence

We are not able to examine the determinants of tax rates and conversions over time because we lack time series data on these outcomes: we only observe tax rates and conversions at the country level at scattered points in time (see Figures A.1, A.3, and A.4). However, there is an *observable* outcome of (arguably) great historical significance that our model can help explain: the Caliphate-wide tax reform of 750 that increased the (uniform) land tax rate on Muslim landholders from the *ushr*/*zakat* to the *kharaj*, and that removed all treaty-based upper ceilings on the *kharaj* that (presumably) existed in certain conquered territories. Our model explains this fiscal policy change by an increase in Caliphs' religiosity and/or budgetary needs, and/or by a decrease in the threat of rebellion and/or reduced uncertainty about Caliphte's rule. In this section, we document the evolution of proxies for these variables from 641 until the end of the First Abbasid

Period in 847. We then assess whether one (or more) of these determinants can account for the tax reform of 750. Nevertheless, since the reform was a Caliphate-wide one-time policy change, it is not possible to formally disentangle the effects of these variables, and we thus rely on theory and history.

### 4.3.1 Data

We measure *Caliph's religiosity* by two proxies: (1) a dummy variable that takes value 1 if the Caliph ruling in a given year is *not* known for holding palace literary and music parties that involved drinking alcohol with his companions (*munadama*); we rely on Sirhan (1978) for the Rashidun (641-661) and Umayyad (661-750) periods and Abu-Zahw (2012) for the First Abbasid period (750-847), and (2) the difference between the standardized number of religious and secular buildings built in a given year from Chaney (2013).[42] We measure *budgetary needs* by the yearly number of major military battles initiated by the Caliphate against its (non-Muslim) neighboring empires drawing on Mikaberidze (2011). Conceptually, *uncertainty about Caliphate's rule* reflects an *external* threat to the Caliphate (outside Egypt) that can alter Egypt's taxpayers' beliefs about the persistence of Muslim rule, whereas the *threat of rebellion* reflects an *internal* threat (within Egypt) that makes taxpayers more likely to rebel in a given year. Nevertheless, it is empirically difficult to disentangle the two variables since an (external) threat to the Caliphate such as a civil war may induce Egyptians to rebel since it weakens the Caliphate's power over its territories. We thus employ three proxies for both variables and are agnostic about which of the two variables is captured by these proxies: (1) the yearly number of major military battles that were initiated by (non-Muslim) neighboring empires against the Caliphate, (2) a dummy variable that takes value 1 if there was a major civil war that threatened the Caliph's tenure (both variables are based on Mikaberidze (2011)), and (3) a dummy variable that takes value 1 if the Nile level in a given year fell in the top or bottom 5% of the Nile maximum levels in 641-1517 drawing on Chaney (2013), as taxpayers were presumably more likely to rebel if economic conditions were adverse.[43] We acknowledge that Nile shocks may also capture (the marginal utility of) income, though, since the Nile level determined Egypt's aggregate agricultural output.

42. Since the numbers of religious and secular buildings are both standardized, the measure controls for the size effect.

43. We are grateful to Roberto Galbiati for his suggestions in this regard.

### 4.3.2 Findings

**Caliphs' religiosity** Figure C.2 in the Online Appendix shows the evolution of our proxies of Caliphs' religiosity. First, the Rashidun and Umayyad Caliphs in 641-750 were less likely to organize palace parties (i.e. were more religious) than their Abbasid successors in 750-847. Put differently, based on this proxy, we fail to find evidence on an increase in Caliphs' religiosity at the time of the tax reform. Second, there is little variation in the difference between (the standardized number of) religious and secular buildings in 641-847. This is probably due to data limitations since most buildings that are recorded in the historical literature belong to later episodes of Egypt's history. But with this caveat in mind, this variable does not suggest either an increase in Caliphs' religiosity at the time of the reform.

**Budgetary needs** Figure C.3 in the Online Appendix shows that our proxy of the Caliphate's budgetary needs, the yearly number of military battles that were initiated by the Caliphate against its neighboring empires, in fact *dropped* after 750. This is not surprising as most major conquests of the Caliphate took place during the Rashidun and Umayyad periods. Thus, based on this proxy we do not find evidence on an increase in budgetary needs at the time of the reform.

**Uncertainty about Caliphate's rule and threat of rebellion** Figure C.4 in the Online Appendix shows our three proxies of the uncertainty about Caliphate's rule and the threat of rebellion. First, major military battles initiated by neighboring empires (mostly, the Byzantine empire) against the Caliphate dropped after 750. Although civil wars within the Caliphate continued to take place after 750, they dropped as the Abbasids were able to consolidate their power. Third, by contrast, Nile shocks do not show a change in trend before and after 750. Thus, based on this proxy we fail to find evidence that the uncertainty about Muslim rule and the threat of rebellion (and economic conditions) declined during the eighth century. Overall, these findings suggest that uncertainty about Caliphate's rule and the threat of rebellion of Egyptian taxpayers both declined during the eighth century. According to our model, this decrease may account for the tax reform of 750. As Egyptian taxpayers became less uncertain over time about the possibility of the fall of the Arab Caliphate, and as their threat of rebellion declined, the Abbasids

probably found this as a good timing to increase the uniform tax. Examining Figure A.1 reveals that the population share of converts increased rapidly between 641 and 750 (bearing in mind the caveats about Courbage and Fargues (1997)'s measure of the population share of converts). According to our model, this increase in converts' share may account for the tax reform of 750, as it mitigated the threat of rebellion over time.

**Summary** We interpret these figures as suggestive of the role of the decline in uncertainty about Caliphate's rule and the threat of rebellion, in driving the increase in the uniform tax rate in 750. Indeed, besides the decline in foreign attacks on the Caliphate and in major civil wars that threatened the Caliphate, the population share of converts increased in 641-750, depressing the threat of rebellion of taxpayers. These factors combined probably made the Abbasid Caliphate more daring to undertake the major reform of increasing the uniform tax rate on Muslims (including both Arabs and converts). Although this resulted in tax revolts in Egypt that now included both Muslims and Copts (see Figure C.5 in the Online Appendix), the Abbasids eventually managed to suppress these revolts by violence, and thus kept the new tax system.

# 5 Conclusion

The paper made two contributions. It first developed a simple model of optimal one-shot and repeated taxation/extraction by a government or a corporation that trades off its hostility towards a group's identity and its reluctance to let exile, conversions or quits erode the contribution base. It provided a set of comparative-statics results (summarized in Table 1) on how discriminatory and non-discriminatory taxes and the erosion of the contribution base are impacted by the ruler's and the governed's identity preferences and marginal utilities of money. Changes in these explanatory variables as well as uncertainty about the ruler's tenure generate interesting fiscal and identity dynamics. The paper identified which results are sensitive to being on the wrong side of the Laffer curve. Finally, it noted that the permanent loss of identity suppresses one's incentive to rebel, and showed that the threat of rebellion against fiscal extraction peters out over time, even when those who have altered their identity stay in the constituency (as is the case for religious conversions).

The second contribution is empirical/historical. The paper considered one particu-

lar historical event, the incentivized conversion of Egyptian Copts following the Arab conquest in the $7^{\text{th}}$ century. While the historical context that we considered was most likely similar throughout the whole Arab Caliphate that spanned the current-day Middle East and North Africa region, we focused on Egypt because its dry-climate Nile Valley preserved the best data source on taxation under the early Arab Caliphate, the tax papyri. Building on novel data sources, including tax papyri in 641-1100, data on churches and monasteries in 1200, and proxies for religiosity of tax authorities, and Copts' religiosity and marginal utility of income, we first provided local-level evidence, showing that enforcer religiosity increased both the discriminatory and non-discriminatory taxes, suggesting taxation on the wrong side of the Laffer curve. The discriminatory tax increased with Copt religiosity, as predicted. Then, using proxies for Caliph's religiosity, budget needs, uncertainty about Muslim tenure, and threat of rebellion, the country-level evidence allowed us to shed some light on factors that may have triggered the Caliphate-wide 750 tax reform lifting the cap on the non-discriminatory tax. The evidence comes in favor of a reduced threat of rebellion/ higher expected Muslim tenure and against an increase in Caliph's religiosity or budgetary needs as drivers of the tax reform. Understanding the determinants of this reform matters not only for its historical significance, but more importantly because the literature mostly treats Islamic taxation as "Islamic," exogenous, and ahistorical, in the sense that it has always existed since the beginning of Islam. To the best of our knowledge, our paper is a first attempt to endogenize, both theoretically and empirically, a major "Islamic" institution.

The theory can in principle be tested in a variety of historical environments where a discriminatory tax was used to induce taxpayers to change their identity by adopting that of the ruling group, and where the optimal mix of discriminatory and uniform taxes evolved in response to changes in taxpayers' identity composition. Examples of religion-based taxes abound Before Arabs, Romans introduced a poll tax from which citizens were exempted, and eventually Roman citizenship became universal. Jews were taxed throughout European history, starting with Roman Emperor Vespasian's Fiscus Judaicus in the first century CE and lasting in many parts of Europe until the $18^{\text{th}}$ or $19^{\text{th}}$ century During the Reformation, conversion of German cities from Catholicism to Protestantism was partly induced by German rulers' promise to Catholics that they could avoid paying the tithe to the Catholic church once they convert to Protestantism (an option that did not

exist before), making it relatively cheaper to switch to Protestantism. And interestingly, the state subsequently introduced a uniform "secular" tax on converted Protestant cities.

In modern economies, taxes can be targeted less explicitly toward unwanted populations. For instance, the 1942 one-off Varlik Vergisi (wealth) tax in Turkey was imposed on all citizens' fixed assets, such as land, buildings, businesses, and industrial enterprises. While on paper a non-discriminatory tax, it affected most severely Jews, Greeks, Armenians, and Levantines, who controlled a large portion of the economy, and led to their exodus (Artunc and Agir, 2017). Finally, while the optimal intervention for the ruler is a tax in our paper, it may take other forms in different environments. Communist countries used membership of Communist Party (a form of "conversion") to screen citizens for positions. Local and national governments' policies with respect to the provision of local public goods for migrants (training, housing, bureaucratic hassle, intolerance toward harassment...) would be equally worth of empirical investigation.

While the empirical evidence we presented in the paper is broadly consistent with the theoretical predictions, we also issued a number of caveats associated with data limitations inherent to this historical period, namely the extremely small number of districts where tax papyri survived, and our inability to observe changes in taxation and conversions over time at a frequency high enough to permit a rigorous econometric analysis. We therefore view this paper as a first step toward further empirical and theoretical studies of optimal taxation with time-persistent status changes and their implications for the tax structure and the dynamics of ruler's legitimacy. We hope that it will stimulate empirical work building on other data sets, which will allow more structural estimations. We leave these promising alleys for research to future work.

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# Appendix for Online Publication

## A Historical Background: Taxes and conversions

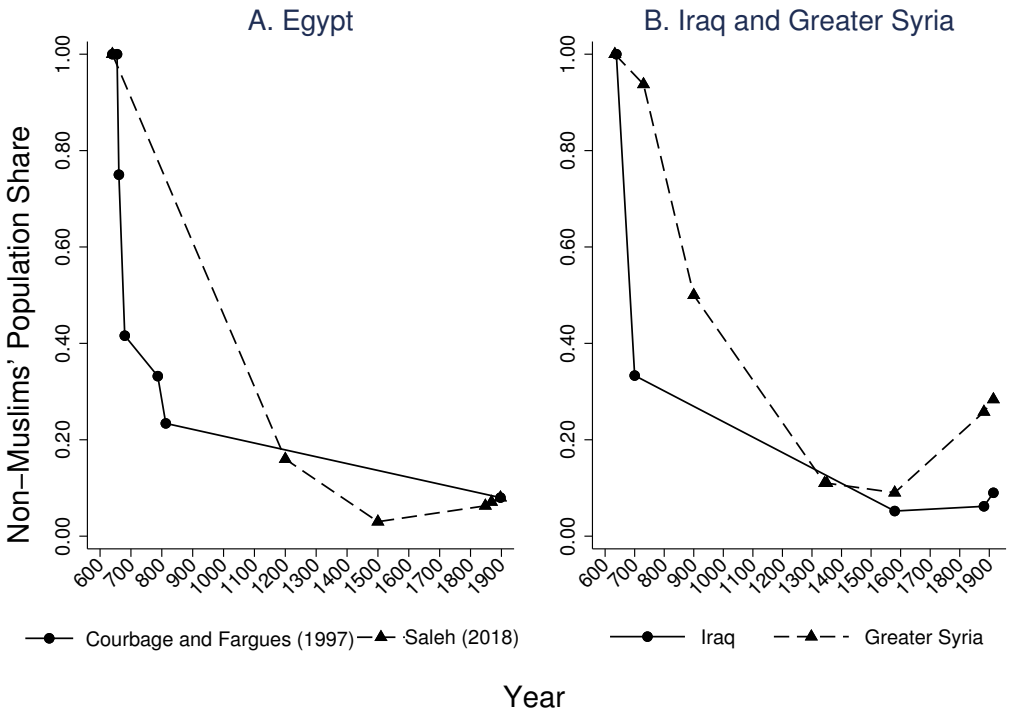



Figure A.1 – **Non-Muslims' population share in 632-1914**

Sources: Courbage and Fargues (1997) and Saleh (2018).

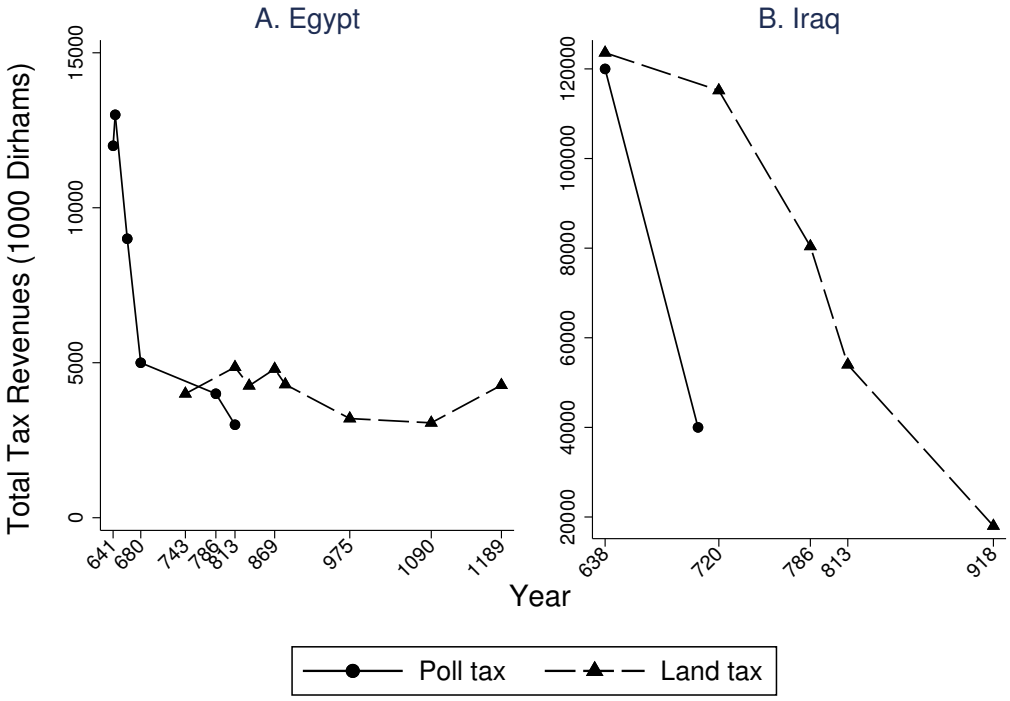



Figure A.2 – **Total poll and land tax revenues in 638-1189**

Source: Courbage and Fargues (1997).

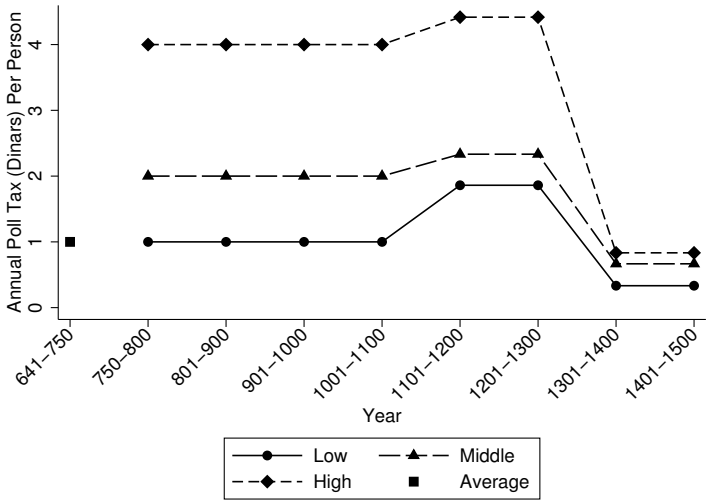



Figure A.3 – ***De jure*** **nominal annual poll tax rate per person in 641-1500**

Notes: Dinar weighs 4.25 grams of gold.
Sources: Ibn-Abdul-Hakam (1974) in 641-750 (according to Morimoto (1981)'s interpretation), jurists' handbooks in 750-1100 (Abu-Yusuf, 1979; Al-Qadi Al-Nu'man, 1963), officials' handbooks in 1101-1500 (Ibn-Mamati, 1991; Al-Qalqashandi, 1914).

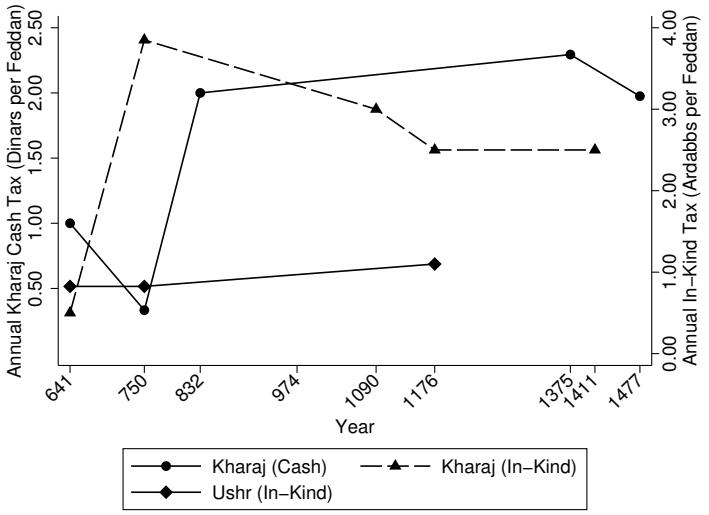



Figure A.4 – ***De jure kharaj* and *ushr* land taxes in 641-1477**

Notes: 1. One dinar equals 4.25 grams of gold. 2. One *ardabb* equals 70 kilograms. 3. One *feddan* equals 6,368 squared meters. 4. Figures for the in-kind *kharaj* and *ushr* taxes are for wheat. 5. I assume an average yield of 11 *ardabbs* of wheat per *feddan* using Ibn-Mamati (1991).
Sources: Secondary medieval narratives in 641 and 832 (Agapius, 1910; Ibn-Abdul-Hakam, 1974; Al-Maqrizi, 1500) according to Morimoto (1981)'s interpretation, jurists' handbooks in 750 and 974 (Abu-Yusuf, 1979; Al-Qadi Al-Nu'man, 1963), officials' handbooks in 1090, 1176, and 1417 (Ibn-Mamati, 1991; Al-Qalqashandi, 1914), and cadastral surveys in 1375 and 1477 (Ibn-Al-Jay'an, 1477).

# B Theory

## B.1 Discrimination through non-price instruments

Consider for instance *racial slurs*. Suppose that the ruler or the majority group has some intrinsic increasing utility $V(s)$ from slur level $s$. Let $1/\theta$ denote the sensitivity to slurs of minority member $\theta \in (0, \infty)$; normalizing the migration cost to 1, type $\theta$ migrates if and only if $\theta \leq \theta^* = s$. Suppose that there are $n_1$ members of the favored group and $n_2$ members of the disfavored one, and that public good $B$ is financed through a non-discriminatory tax. Then the tax levied on the disfavored group is $R(\theta^*) = \frac{n_2[1-F(\theta^*)]}{n_1+n_2[1-F(\theta^*)]}$ and so the utility of a ruler who stands only for the majority interests is $W(\theta^*) = V(\theta^*) + R(\theta^*) - B$. Note that the optimal policy always lies on the wrong side of the Laffer curve ($R'(\theta^*)<0$), which is natural since "taxing" the minority through slurs (or violence) brings no revenue.

Next consider *patronage*. Suppose that for each civil service job opening, there are both a majority and a minority candidates. The ruler takes a minority member if and only if her quality advantage is $\theta \geq \theta^*>0$. Let $V(\theta^*)$ denote the patronage benefit for

the majority, an increasing function. The quality of public goods, expressed in monetary terms, is $R(\theta^*)$, a decreasing function. If for instance all citizens must compensate a poor quality of public services by an equivalent increase in private expenditures, then the ruler's welfare, $V(\theta^*) + R(\theta^*)$, can be decomposed into the familiar two terms. Again, the optimal policy always lies on the wrong side of the Laffer curve.

**Proof of Proposition** 1′

We can subsume the two cases by introducing $B_C(\theta^*)$ and $B_M(\theta^*)$, the image or externality benefits when remaining Copt and when converting.

Let $D(\theta^*) \equiv B_C(\theta^*) - B_M(\theta^*)$ denote the difference. The cutoff is determined by:

$$\theta^* - \tau + D(\theta^*) = 0, \text{ yielding a function } \tau(\theta^*).$$

The ruler's welfare is then

$$W = [\tau(\theta^*) - c][1 - F(\theta^*)] + B_M(\theta^*) + \int_{\theta^*}^{+\infty} [1 - \delta(\theta)][\theta - \theta^*]dF(\theta) - B.$$

The first-order condition is

$$\theta^* - c - \frac{\int_{\theta^*}^{+\infty} \delta(\theta)dF(\theta)}{f(\theta^*)} = \frac{F(\theta^*)}{f(\theta^*)}B'_M(\theta^*) + \frac{1 - F(\theta^*)}{f(\theta^*)}B'_C(\theta^*) - D(\theta^*). \tag{B.1}$$

For image concerns

$$D(\theta^*) = \mu[M^+(\theta^*) - M^-(\theta^*)],$$

$$B'_M(\theta^*) = \mu\frac{f(\theta^*)}{F(\theta^*)}[\theta^* - M^-(\theta^*)],$$

and

$$B'_C(\theta^*) = \mu\frac{f(\theta^*)}{1 - F(\theta^*)}[M^+(\theta^*) - \theta^*].$$

And so the RHS of (B.1) is equal to 0.

For network externalities,

$$D(\theta^*) = e_C[1 - F(\theta^*)] - e_M F(\theta^*),$$

$$B'_M(\theta^*) = e_M f(\theta^*),$$

and

$$B'_C(\theta^*) = -e_C f(\theta^*).$$

The RHS of (B.1) is equal to

$$2[e_M F(\theta^*) - e_C[1 - F(\theta^*)]].$$

## B.2 Proofs

**Proof of Proposition 7** Let us first assume that in the static model the marginal rebel is a convert, and so the land tax is constrained to be such that $\lambda = \hat{\lambda}$ where $\hat{\lambda} + \hat{\theta} = \rho$ (see section 4). Suppose that at date 1 the Muslim ruler sets taxes $\lambda_1 = \hat{\lambda}$ and $\tau_1 = \hat{\tau}$ such that $\hat{\lambda} + R(\hat{\tau}) = B$ and $\hat{\lambda} + \hat{\tau} = \rho$. This tax scheme is the best that can be achieved from the point of view of date 1 without generating a rebellion. At date 1, $F(\hat{\theta})$ convert.

The key observation is that at date 2, the converts will not participate even in a successful rebellion as long as $\lambda_2 \leq \rho$, because at that point of time they already have abandoned their Coptic religion and therefore are unaffected by an increase in the poll tax. So there is overall less resistance to taxation. The no-rebellion constraint at date 2, $\lambda_2 \leq \rho$ is therefore looser than the date-1 no-rebellion constraint. This implies that

$$\lambda_2 = \min\{\rho, \lambda^*\} \quad \text{and} \quad R(\tau_2) = B - \lambda_2.$$

Because $\lambda_2 > \lambda_1$, $R(\tau_2) < R(\tau_1)$ and so $\tau_2 > \tau_1$ if the optimal tax $\hat{\tau}$ is on the wrong side of the Laffer curve. So if $\lambda^* \leq \rho$, the ruler obtains his first-best welfare at date 2 and a fraction $F(\theta^*) - F(\hat{\theta})$ convert at date 2. In contrast, if $\lambda^* > \rho$, then $\lambda_2 = \rho \geq \lambda_1$ and $R(\tau_2) = B - \rho \leq R(\tau_1)$. The fraction of new converts is then smaller than $F(\theta^*) - F(\hat{\theta})$. When the optimal tax is on the right side of the Laffer curve, the relaxation of the rebellion constraint also would allow the ruler to raise the non-discriminatory tax, which would enable reducing the discriminatory one (as $R' > 0$). However, the apostasy constraint ($\theta_2^* \geq \theta_1^*$) implies that there is no point reducing the pool tax; so an optimal tax is $\tau_2 = \tau_1$ and $\lambda_2 = \lambda_1$ (the outcome is the same as in the static context).

Next, suppose that the marginal rebel is a non-convert in the static model and so the marginal revel is still affected by both taxes at date 2. At date 1, taxes are given by $\lambda_1 + \tau_1 = \rho < \lambda^* + \tau^*$ and $\lambda_1 + R(\tau_1) = B$. Assuming that the discriminatory tax is on the wrong side of the Laffer curve, $\lambda_1 < \lambda^*$, $\tau_1 < \tau^*$ and $\theta_1 < \hat{\theta}$. In contrast with the other case, the no-rebellion constraint is not relaxed at date 2: $\lambda_2 + \tau_2 \leq \rho$, and so $\lambda_2 = \lambda_1$ and $\tau_2 = \tau_1$. There are no new conversions at date 2. The same holds if the optimal tax is on the right side of the Laffer curve. ■

**Proof of Corollary 1** Suppose that, in the absence of constraint on the tax system, at date 1, (a) the marginal rebel is a convert: $\lambda_1 + \hat{\theta} = \rho \leq \lambda_1 + \tau(\lambda_1)$, where $\lambda + R(\tau(\lambda)) \equiv B$; and (b) the tax system is on the wrong side of the Laffer curve: $R'(\tau(\lambda)) < 0$ or equivalently $\tau(\lambda)$ is an increasing function; and (c) reintroducing the constraint on the

tax system, the latter is non-binding: $\lambda_1 \leq \lambda_u$ where $\lambda_u$ is the *ushr* rate. So there is no gain of removing the cap constraint at date 1. Let us assume that $\lambda_u < \rho$.

Now suppose that in the absence of both the rebellion constraint and a cap on the uniform tax, the optimum is $(\lambda^*, \tau^*)$ (which solves $\max\{W(\tau)\}$ and satisfies $\lambda + R(\tau) = B$). One has $\lambda_1 < \lambda^*$ and $\tau_1 < \tau^*$. If $\lambda_1 < \lambda_u < \lambda^*$, there is a strict gain at date 2 for the ruler to remove the cap on the uniform tax, while there was none at date 1. Given that at date 1 Copts with religiosity $\theta \leq \hat{\theta}$ have converted at date 1, there is no rebellion at date 2 provided that $\lambda_2 \leq \rho$. The tax reform enables the ruler to implement $\lambda_2 = \min\{\lambda^*, \rho\}$.[44]

44. One must check that date-1 converts indeed behave myopically. The option value of remaining Copt can be positive only if the agent remains Copt at date 2, i.e. if $\theta > \tau_2$. But $\theta \leq \hat{\theta} = \tau_1 < \tau_2$.

# C Empirics

## C.1 Local-level evidence

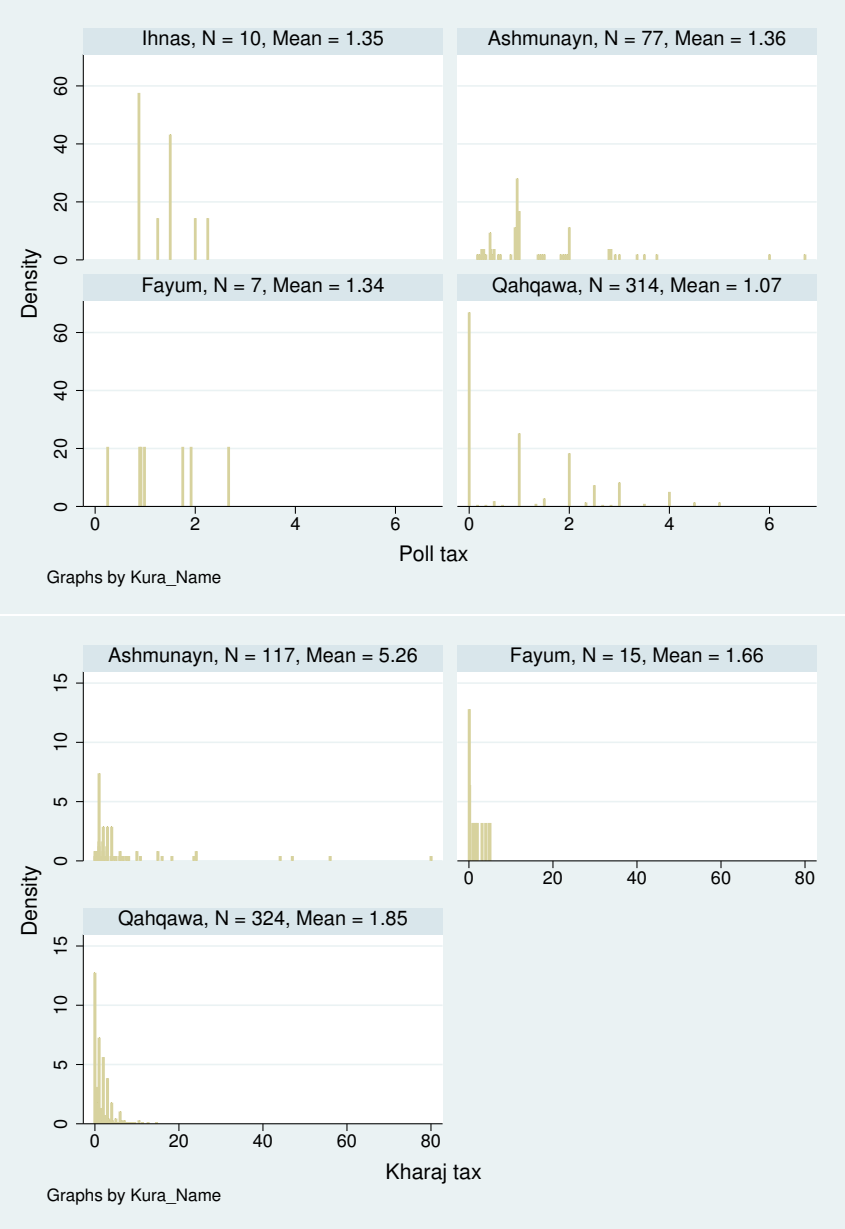



Figure C.1 – **Histogram of poll and *kharaj* tax rates by *kura* in 641-1100**

Notes:

1. Arab settlement is equal to 1 in *Ihnas*, *Ashmunayn*, and *Fayum* and equal to 0 in *Qahqawa*.
2. Date ranges of poll tax payments are 701-900 in *Ihnas*, 731-1100 in *Ashmunayn*, 641-1005 in *Fayum*, and 703-733 in *Qahqawa*.
3. Date ranges of *kharaj* tax payments are 801-1100 in *Ashmunayn*, 641-1100 in *Fayum*, and 703-733 in *Qahqawa*.

Source: Individual-level poll and *kharaj* tax payments in 641-1100 from Greek and Arabic papyri in Morimoto (1981, pp. 67-79, 85-87) and the Arabic Papyrology Database. Sample is restricted to tax payments in papyri with a known *kura*.

## C.2 Country-level evidence

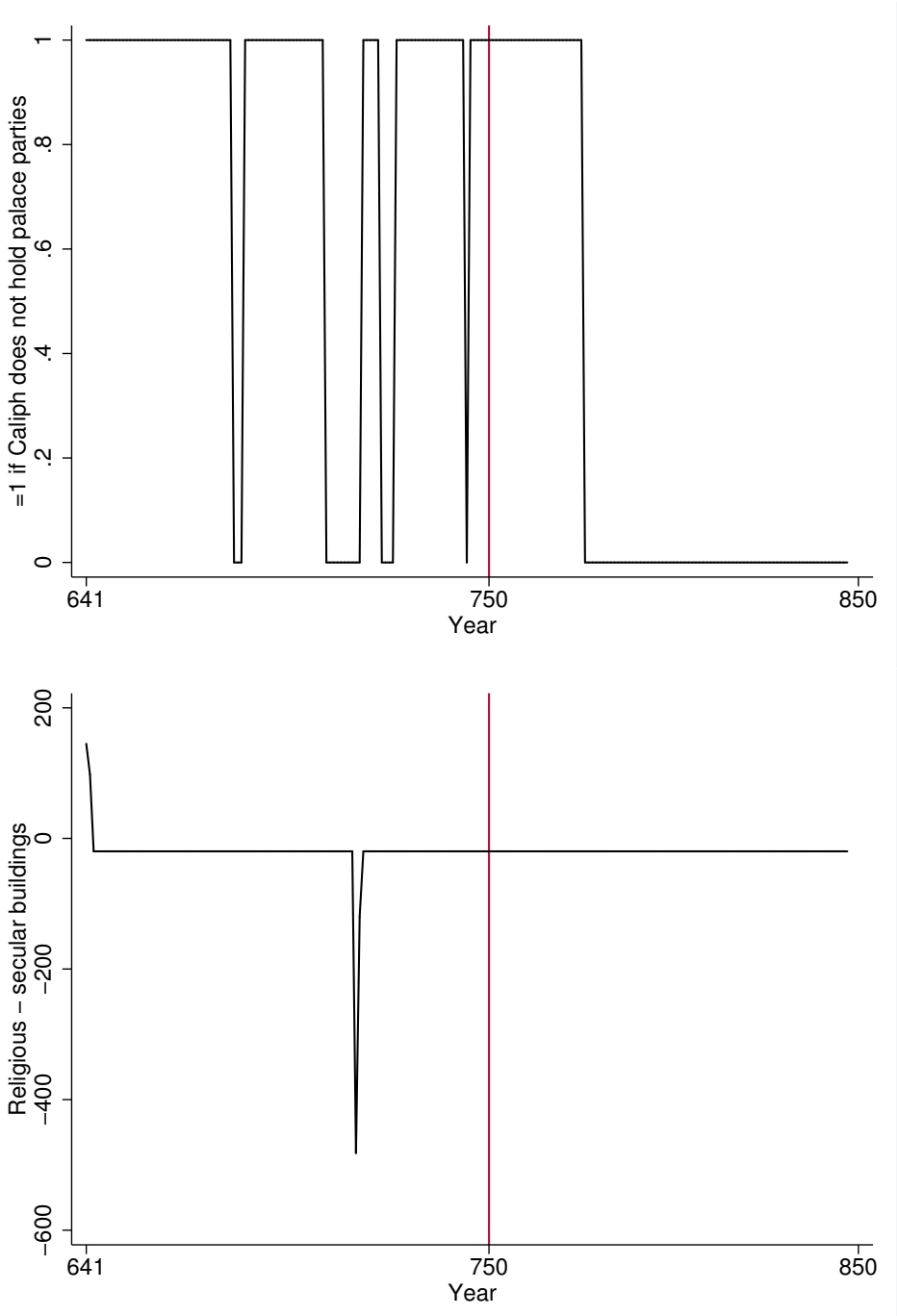



Figure C.2 – **Caliphs' religiosity in 641-847**

Source: See text.

Table C.1 – **Determinants of *kharaj* per unit of land in 1375 and 1477**
Village-level regressions - Dependent variable: *'Ibra* per *feddan*

(a) 1375

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | 1.698 | | | 1.326 | 3.320 |
| | (0.644)** | | | (0.458)** | (1.128)*** |
| | {0.472}*** | | | {0.381}*** | {0.967}*** |
| =1 if village on Holy Family route | | 0.097 | | 0.160 | |
| | | (0.637) | | (0.455) | |
| | | {0.596} | | {0.458} | |
| Log (urban population) in *kura* circa 300 | | | 0.778 | 0.488 | |
| | | | (0.299)** | (0.214)** | |
| | | | {0.275}*** | {0.262}* | |
| Obs (villages) | 386 | 383 | 386 | 383 | 386 |
| Clusters (*kuras*) | 18 | 18 | 18 | 18 | 18 |
| Clusters (districts) | 35 | 35 | 35 | 35 | 35 |
| $R^2$ | 0.016 | 0.000 | 0.012 | 0.020 | |
| KP Wald F-stat | | | | | (13.483) |
| | | | | | {22.699} |
| Mean dependent variable | 3.741 | 3.741 | 3.741 | 3.741 | 3.741 |
| SD dependent variable | 5.237 | 5.237 | 5.237 | 5.237 | 5.237 |

(b) 1477

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | 1.318 | | | 1.047 | 3.077 |
| | (0.580)** | | | (0.441)** | (1.062)*** |
| | {0.436}*** | | | {0.406}** | {0.918}*** |
| =1 if village on Holy Family route | | -0.285 | | -0.234 | |
| | | (0.710) | | (0.570) | |
| | | {0.671} | | {0.578} | |
| Log (urban population) in *kura* circa 300 | | | 0.577 | 0.350 | |
| | | | (0.324)* | (0.262) | |
| | | | {0.290}* | {0.292} | |
| Obs (villages) | 386 | 383 | 386 | 383 | 386 |
| Clusters (*kuras*) | 18 | 18 | 18 | 18 | 18 |
| Clusters (districts) | 35 | 35 | 35 | 35 | 35 |
| $R^2$ | 0.011 | 0.000 | 0.007 | 0.013 | |
| KP Wald F-stat | | | | | (13.483) |
| | | | | | {22.699} |
| Mean dependent variable | 3.156 | 3.156 | 3.156 | 3.156 | 3.156 |
| SD dependent variable | 4.931 | 4.931 | 4.931 | 4.931 | 4.931 |

Notes: Sample is restricted to villages in the Nile Valley. Robust standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets. $*p < 0.10, **p < 0.05, ***p < 0.01$. A constant is included in all regressions. The coefficient on *kura*'s distance to *Arish* in the first-stage regression of the Arab settlement dummy variable in both 1375 and 1477 is − 0.003 (0.001)*** {0.001}*** (standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets). KP Wald F-Stat in parentheses corresponds to clustering standard errors at the *kura* level in the first stage, and in curly brackets to clustering at the district level.
Source: See text.

Table C.2 – **Determinants of conversions in 1500**

*Dependent variable = 1 if at least one Coptic church or monastery in village*

| | OLS | | | | IV |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| =1 if Arab settlement in *kura* in 700-969 | -0.034 | | | -0.035 | -2.194 |
| | (0.025) | | | (0.022)$^{+}$ | (7.285) |
| | {0.018}$^{*}$ | | | {0.017}$^{**}$ | {5.421} |
| =1 if village on Holy Family route | | 0.310 | | 0.309 | |
| | | (0.072)$^{***}$ | | (0.073)$^{***}$ | |
| | | {0.088}$^{***}$ | | {0.088}$^{***}$ | |
| Log (urban population) in *kura* circa 300 | | | 0.002 | 0.004 | |
| | | | (0.010) | (0.008) | |
| | | | {0.010} | {0.008} | |
| Obs (villages) | 1817 | 1817 | 1817 | 1817 | 1817 |
| Clusters (*kuras*) | 42 | 42 | 42 | 42 | 42 |
| Clusters (districts) | 75 | 75 | 75 | 75 | 75 |
| $R^2$ | 0.008 | 0.047 | 0.000 | 0.055 | |
| KP Wald F-stat | | | | | (0.083) |
| | | | | | {0.155} |
| Mean dependent variable | 0.028 | 0.028 | 0.028 | 0.028 | 0.028 |
| SD dependent variable | 0.164 | 0.164 | 0.164 | 0.164 | 0.164 |

Notes: Robust standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets. * $p$ <0.10, ** $p$ <0.05, *** $p$ <0.01. A constant is included in all regressions. The coefficient on *kura*'s distance to *Arish* in the first-stage regression of the Arab settlement dummy variable is − 0.000 (0.001) {0.001} (standard errors clustered at the *kura* level are in parentheses and at the district level in curly brackets). KP Wald F-Stat in parentheses corresponds to clustering standard errors at the *kura* level in the first stage, and in curly brackets to clustering at the district level.
Source: See text.

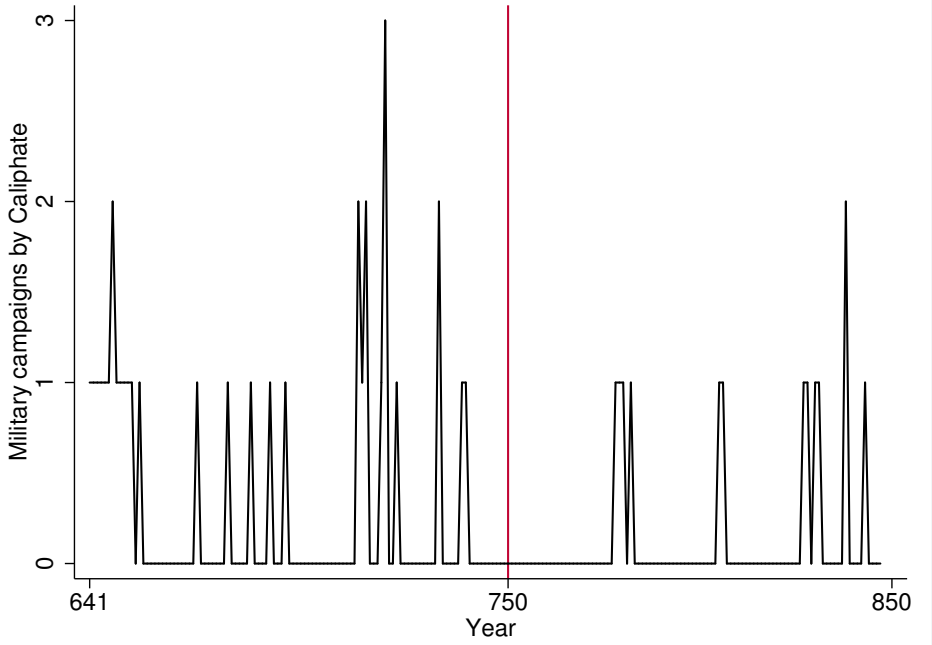



Figure C.3 – **Caliphate's budgetary needs in 641-847**

Source: See text.

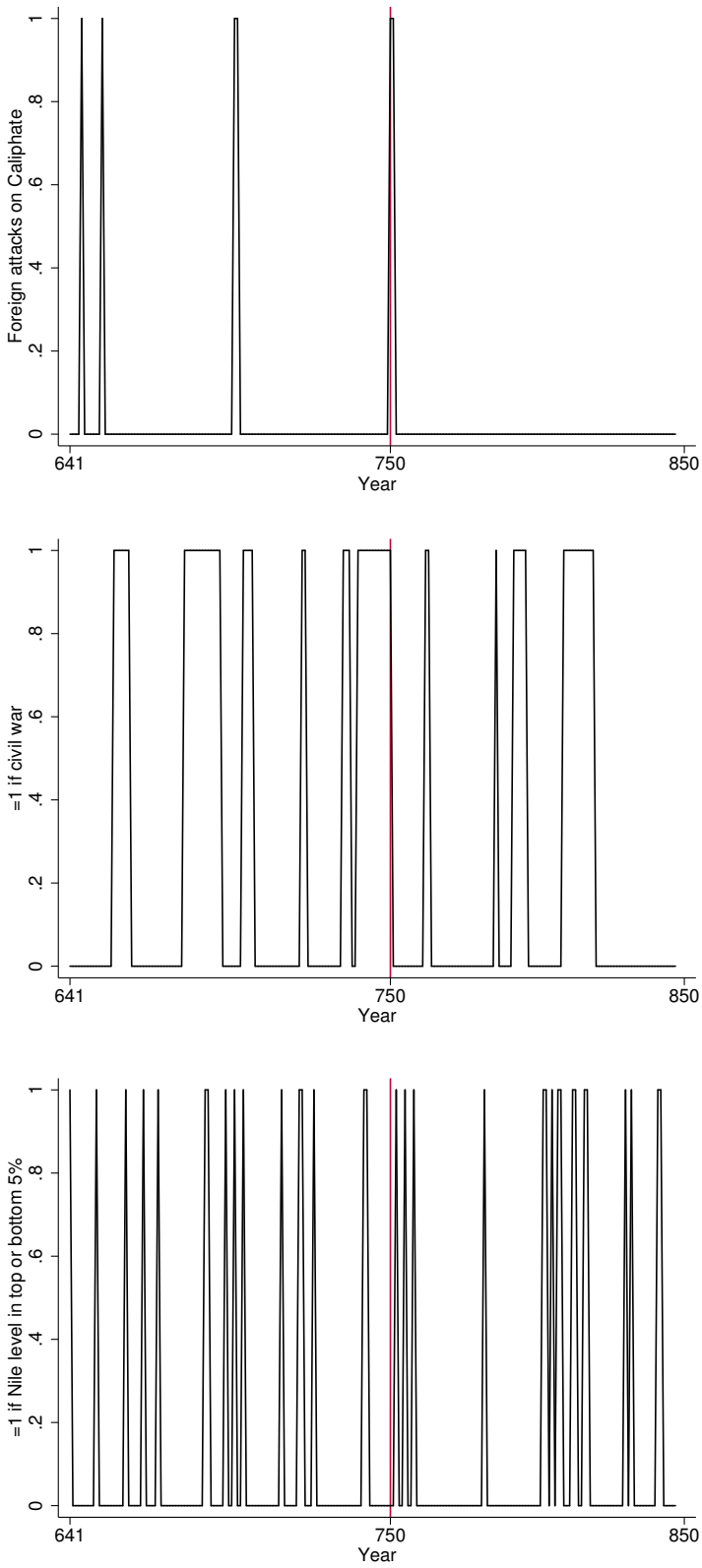



Figure C.4 – **Uncertainty about Caliphate's rule and threat of rebellion in 641-847**

Source: See text.

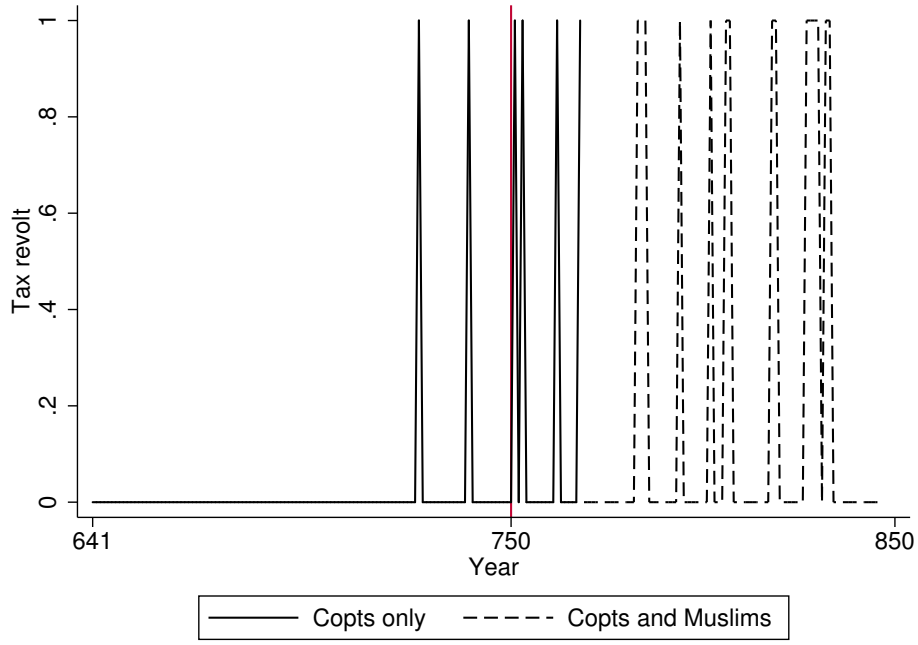



Figure C.5 – **Egypt's tax revolts in 641-847**

Source: See text.