FOR-PROFIT STATES AND BIG GODS[1]

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ABSTRACT: Over the past two millenia successful pre-modern states adopted and cultivated Big-God religions that emphasize (i) the ruler's legitimacy as divinely ordained and (ii) a morality adapted for larger societies that can have positive economic effects. We make sense of this development by building on previous research that has conceptualized pre-modern states as maximizing the ruler's profit. We model the interaction of rulers and subjects who have both material and psychological payoffs, the latter emanating from religious identity. Overall, religion reduces the need to control subjects through the threat of violence, increases production, increases tax revenue, and can reduce banditry. A Big-God ruler has incentives to invest in expanding both the number of believers and the intensity of belief.

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1 Introduction

After the conversion of Roman Emperor Constantine in the early fourth century CE, Christianity spread through Europe so that a millenium later no single ruler of note was a heathen. Similarly, Islam was adopted by all rulers in large parts of Asia and North Africa, most notably by, the militarily dynamic but initially administratively weak, steppe nomad confederations. Even Judaism, not known for its missionary zeal, was apparently adopted by Khazaria's ruling elite in the eighth century. Later, of course, monotheism spread to most other parts of the world. Even states that did not adopt monotheistic religions - such as China and states in South and Southeast Asia - encouraged and emphasized religious practices that have some important similar effects as monotheism.

What accounts for the apparent advantage of rulers who adopted and cultivated such religions? I argue that monotheism and related Big-God religions (the latter term introduced by Norenzayan, 2013) confers two advantages. First, a Big God confers streamlined and direct legitimacy and status to the ruler as "there is a single God and his representative on earth is the King" or confers "the Mandate of Heaven." The ruler's subjects can even identify psychologically with the ruler and "give Ceasar what belongs to Caesar."[2]

Second, Big-God religions encourage moral behavior and contribute to large-society cooperation. A Big God is all-knowing and monitors behavior 24 hours a day and 7 days a week, even though that he might not even need to do so when morality and a sense of guilt are sufficiently internalized by individual believers. Big-God religions encourage moral behavior that contributes to large-society cooperation.

These advantages can translate into greater than otherwise revenue and profits for the ruler. At high levels of belief, Big God's monitoring and greater moral behavior of his subjects reduce the ruler's costs in providing internal security against bandintry and common crime. Moreover, moral behavior facilitates economic exchange and increases overall economic activity. The legitimacy and status of the ruler reduces his subjects' resistance, and his cost, of taxation. Investing in Big God and turning almost all subjects to believers is also a profit-maximizing strategy for the ruler.

We examine these effects of Big-God religion within a model in which rulers maximize their profit, the difference between tax revenue and the cost of running the state. This is an approach used by a number of economists and other social scientists in thinking and modeling pre-modern states.[3] In all of the existing models the payoffs of rulers and subjects are material payoffs. To account for the effects of religion, we introduce psychological payoffs in subjects in accordance

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[2] There is a long debate about the meaning of the phrase and its surrounding text in the New Testament that partly revolves around its meaning about the separation of Church and State. That does not concern us here. The phrase itself implies the legitimacy and the right of the ruler to taxes.

[3] They include Levi (1988), Engineer (1989), Findlay (1991, 1996), Olson (1993), Grossman and Noh (1994), McGuire and Olson (1996), Robinson (1997), Konrad and Skaperdas (1998, 2007, 2012), Wintrobe (1998), Skaperdas (2001, 2014), Moselle and Polak (2001), Myerson (2008), North, Wallis, and Weingast (2009), Leeson (2014), and Vahabi (2016a, 2016b).

with evidence in the psychological literature (Tajfel, 1981) and applications in modeling identity in individual behavior and game-theoretic models (see Kalin and Sambanis, 2018, for a recent review).

What we do not consider in this paper explicitly is the military competition between rulers that has been historically important. Nevertheless our findings inform long-run patterns of Eurasia's history. For a state to survive it had to be able to defend itself against other states, especially heathen ones. The gradual conversion or conquest of heathen rulers by Big-God ones appears to have been the long-run outcome over the past two millenia (and before modern times). In the meantime, there were plenty of heathen rulers and states that invaded and subjugated Big-God rulers and states. Goth, Frank, and other Germanic rulers invaded a weak Roman Empire that was in the process of Christianization before the rulers themselves converted to Christianity. Similar trajectories were followed by Viking and Slav rulers raiding and even conquering Christian states before themselves becoming converts. Huns, Mongols, and Turks raided almost all of Eurasia and conquered a big chunk of it but they did not establish lasting states until they converted to Islam themselves. Likewise, the last Imperial dynasty of China that lasted for almost three centuries was created by steppe conquerors, the Qing/Manchus, who kept and adopted traditional Chinese culture, religious practices, and statecraft.

There were also many cases in which the heathens were repelled and conquered themselves, but our findings are consistent with the pattern we have just described in the following sense: Big-God religions provide greater wealth to the rulers who adopt them; this wealth attracts continual probing and occasional conquest by less wealthy, fringe rulers without Big Gods; the new rulers themselves find Big Gods more profitable to adopt and the cycle starts anew with new probings from the fringes of "civilization." This cyclical historical pattern has been long identified by the 14th century Arab historian and social scientist Ibn Khaldûn (1994) who had emphasized the gradual "softening" that occurs in sedentary civilizations that makes them ripe for conquest by hardened mountaineers and nomads. Our approach of course does not preclude that but focuses on the advantage conferred by greater ruler legitimacy and large-society morality brought about by Big Gods. Given the historical record, it is not individual state survival that a Big God facilitates but, through its profit advantage, a Big God lengthens its own chance of survival by inducing successive heathen conquerors to convert as well as keeping the uncoquered in its camp.

In the next section we briefly discuss the historical context of Big-God religions, their adoption by states, and the possibility of introducting psychological payoffs in economic, rational-choice models. We then examine a setting without a state – anarchy – in which the population sorts itself between producers and bandits in the presence of both believers and heathens, the former paying a psychological penalty for being bandits. Producers engage in both self-protection and production. As the fraction of believers increases there is a step-wise increase in the number of producers. In the subsequent two sections we introduce and examine a ruler who provides security as a public good but also uses the input for the public good - guards who are specialists in violence - to extract

revenue from producers. Believers value the status and prestige of the ruler and devote, relative to heathen producers, fewer resources to self-protection and more to production. A Big-God ruler has higher profits than a heathen rule at low enough and high enough fraction of believers. We then analyze the incentives for a ruler to invest in converting the population to believers and for intensifying moral beliefs and enhancing his own status and legitimacy. The incentives for a ruler to invest in temples, churches, or mosques, in priests, or in regularized rituals appears to be high beyond a certain level of believers; that is when religion becomes nearly a monopolistic affair of the state. That is also when the moral and legitimacy functions in Big God work in complementary fashion and maximize the ruler's profits. In the final section of the paper we offer concluding remarks.

2 Empires, Religion and Individual Psychology

There are two main instruments for rulers to gain, maintain, and enhance their power: The Sword and the Word; violence (and the threat of violence) and persuasion. The latter includes *ideologies* and *religion* that could be considered forms of *congealed* persuasion, the accumulated arguments and understadings from the past that make people make sense of their world.

The rulers of the earliest empires that appeared in Eurasia and Egypt were likely using persuasion mechanisms to enhance their legitimacy and for ther populations to identify with their rule. Although the evidence is thin on that dimension[4] it does point to a gradual movement from high, if not almost exclusive, reliance on brute force (the Hittite empire) to becoming more based on the status or prestige of the ruler - the Assyrian and Persian empires, for example, appeared to use a "softer touch". Yet, early forms of Big over-arching Gods do not appear to have penetrated the beliefs of the masses. Zoroastrianism, for instance, was an early form of monotheism that was adopted by the Persian empire but was essentially a religion of the elites.

The available evidence points as well to a gradual emergence and spread of morality and prosociality fit for larger societies. Norenzayan (2013, Ch. 7) surveys the historical and other evidence.[5] Ritual and constant visual reminders (houses of worship) that enhance the ruler's prestige and legitimacy and increase moral conformity. Big Gods intensified the monitoring and the discipline with which large populations shared common norms and abided by them.

Associated with the spread of a new individual morality is the "spiritual and intellectual awakening" that occurred during the *Axial* Age, around the 5th and 4th centuries BCE, almost simultaneously across Eurasia (Jaspers, 2011[1949]). From Plato and Socrates in Greece, to the Bhudda in India, to Confucius and

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[4]Finer (1997), Mann (1986), Dudley (1991), and Cunliffe (2017) provide overviews and evidence on early empires.

[5]Evidence includes game experiments in different types of socieities, including hunter-gatherers. For example, Henrich et. al. (2001) have found that individuals from less complex societies behave in a less pro-social fashion in ultimatum, public-good, and dictator games.

Mencius in China, philosophies, ideologies, and religions were articulated that emphasized what we now consider self-evident individual morality in a large society. The ideas and thoughts took centuries and milemnia to spread around the world and to the nooks and crannies of societies. Rulers picked up on the great thinkers and started propagating their thoughts, but of course with twists that could be considered self-interested on the part of the rulers. Confucius' thought, for instance, was adopted by many Chinese Warring states rulers and by the Han emperors afterwards, but with an emphasis on social hierarchy that has been argued did not exist in Confucius' thought itself (Creel, 1949).

From an economic, rational-choice perspective, the two effects of Big-God religion that we examine - the enhancement of ruler's legitimacy and the spread of morality - work themselves through individual psychological payoffs. These payoffs are part of the identities of individuals as first argued within economics by Akerlof and Kranton (2000). We employ the particular modeling approach, based on the psychological literature (such as Tajfel, 1981), in Shayo (2009), Sambanis and Shayo (2013), and Sambanis et.al (2015) that has been used to model social identities in modern times.

The model and approach are also consistent with those of the economics of religion literature (see Iannaccone, 1998, for an overview). If anything, especially compared to models that are intended to explain specific aspects of modern religious behavior, ours is too simple (or even too simplistic) but this has to be necessarily so for tractability as we intend to understand a long-run macro-historical phenomenon that involve multiple actors. One particular study that complements our approach is that of Raskovich (1996) who provides an intriguing industrial-organization perspective on the emergence of Yahweh as a single God out of multiple pagan cults and gods, partly encourage by Israelite kings such as David.

3   Anarchy with Morality

The defining characteristic of states is the problem of security: personal, physical, or property security. Economic activity presupposes basic security and other public goods cannot be provided safely without security. To clarify ideas and serve as a basis of comparison with the subsequent modeling of states under for-profit rulers, we begin with anarchy, a setting in which security is the main concern and the population sorts itself between *producers* and *bandits*. To the analogous framework of Konrad and Skaperdas (2012), in which individuals care solely about material payoffs, we add psychological payoffs that *believers* have depending on whether they become producers or bandits. For simplicity, non-believers (or *heathens*) only care about material payoffs.

Each poducer has one unit of a resource that he can distribute between work and self-protection – the higher is the level of self-protection, the lower is the amount of work and the lower is the output that can be produced. Denoting this self-protection activity by x, a producer can keep a share $s(x)$ of output away from bandits, where $s(x)$ is increasing, differentiable, and strictly concave

in x, with $s(x) \in [0,1], s(0) = 0$ and $s(1) = 1$.

Believers who become producers have the additional psychological payoff $\mu_p > 0$, so that their total payoff becomes:

$$U_{\mu p}(x) = s(x)(1-x) + \mu_p \tag{1}$$

Heathens who become producers have the corresponding material payoff only:

$$U_{hp}(x) = s(x)(1-x) \tag{2}$$

Each producer chooses a level of self-protection x so as to maximize their payoff. Let x^* denote the unique such level of optimal self-protection, which is independent of the psychological payoff μ_p (and thus both believer and heathen producers choose the same level of self-protection).

Bandits are looking for producers to prey upon. Let p denote the number of producers and let b represent the number of bandits so that $p + b = 1$. All bandits have the same material payoff $[1 - s(x^*)](1 - x^*)\frac{p}{b} = [1 - s(x^*)](1 - x^*)\frac{p}{1-p}$. That is, bandits extract $1 - s(x^*)$ of output from each producer who has not been previously robbed and the more peasants there are relative to bandits, the better it is for a bandit. Then, letting $s^* \equiv (x^*)$, the payoffs of believer and heathen bandits are:

$$U_{\mu b}(p) = (1 - s^*)(1 - x^*)\frac{p}{1-p} - \mu_b \text{ where } \mu_b > 0 \tag{3}$$

$$U_{hb}(p) = (1 - s^*)(1 - x^*)\frac{p}{1-p} \tag{4}$$

That is, a believer who becomes a bandit has a positive psychological cost μ_b. Let $U_{\mu p} \equiv s^*(1 - x^*) + \mu_p$ and $U_{hp} \equiv s^*(1 - x^*)$.

We are interested in determining the shares of the population who become producers and bandits as a function of their identities and other parameters. In particular, we define an *anarchic equilibrium* to be a number of peasants p^*, a number of bandits b^*, such that $b^* = 1 - p^*$ and no producer wants to become a bandit $(U_{ib}(p^*) \geq U_{ip}$ for $i = \mu, h)$ and no bandit wants to become a producer $(U_{ib}(p^*) \leq U_{ip}$ for $i = \mu, h)$. The equalities in payoffs hold when there are both producers and bandits of an identity; strict inequalities can hold only when those with an identity become solely either producers or bandits.

The number of producers and bandits depends on the relative number of believers and heathens in the population. Let $\beta \in [0,1]$ denote the proportion of the population that are believers. Proposition 1 summarizes the anarchic equilibrium for the various values of believers.

Proposition 1: *There is a unique anarchic equilibrium for every fraction of believers $\beta \in [0,1]$. In particular:*

(i) When $\beta \in [0, s^*]$, the equilibrium number of producers equals the share kept by each producer ($p^* = s^*$). All the believers become producers, $s^* - \beta$ of heathens become producers and the remainder $(1 - s^*)$ become bandits.

(ii) When $\beta \in [s^*, \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}]$ (where $\mu \equiv \mu_p + \mu_b$), all believers become producers and all heathens become bandits ($p^* = \beta$).

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(iii) When $\beta \in [\frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}, 1]$ $p^* = \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$, all heathens become bandits. All producers are believers but $\beta - \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$ believers become bandits.

(For the proof, please see the Appendix.)

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Figure 1 about here

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Figure 1 shows how the number of producers varies with the number of believers in a step-wise fashion. Total output, being proportional to the number of producers $(p^*(1 - x^*)$, follows exactly the same trajectory. At a proportion of believers below the share of output that producers keep away from bandits (i.e., s^*), producers do not increase as the number of believers increase - over that range, any extra believers become producers and the displaced heathen producers are replaced by heathen bandits, not changing the essential of the anarchic equilibrium in the complete absence of believers.

The effect of believers on the economy becomes substantial after they reach the critical mass of s^*. As the proportion of believers increases beyond that level all extra believers become producers and displace heathens who are bandits. The remaining heathens are all bandits whose payoff nevertheless increases as the number of believer producers increases.

This process of strictly increasing producers in the number of believers is arrested when believers reach such a level - and heathens are reduced sufficiently - so as to tempt some believers to become bandits. That threshold level $(\frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu})$ depends positively on the sum (μ) of the psychological benefit of a believer-producer and the psychological cost of a believer-bandit as well as on the self-protection share of producers s^*. Even when everybody is a believer the number of producers remains at that level - despite the psychological cost there are too many producers to prey upon and forgo the material benefits of banditry.

Thus far, all security is individually provided. Morality can help increase production and reduce banditry but even when everybody is a believer it cannot completely eliminate banditry. A possibly complementary alternative to morality is greater levels of security that could be provided by the community more efficiently than could be provided individually; building houses close to one another to effectively have a fort, having a militia, developing a legal and justice system. Ideally such collective security could be provided by a self-governing community. However, a "Leviathan," a for-profit ruler could also provide such security. The problem is that for-profit rulers could use the means of violence at their disposal not just against bandits but also against the producers themselves and extract from them even more than bandits ever could. Konrad and Skaperdas (2012), in models with material payoffs only, show that self-governing communities are best in term of material welfare. However, they are at a severe disadvantage in the presence of for-profit rulers when they have to fight against them to maintain their independence. Self-governing communities have

to be small to control free-rider problems but they face formidable problems in controlling both internal and external security, the latter agains for-profit rulers. This is consistent with the dearth of self-governing communities in history. Therefore, for simplicity in the remainder we will examine models with for-profit rulers providing collective security.

4 Big-God Ruler: Preliminaries

In addition to producers taking self-protection measures, we now introduce a single ruler who can provide security as a public good by hiring guards and having other means at his disposal to protect producers against bandits. Let $g \in [0, \bar{g}]$ denote the number of *guards,* the input to the public good that provides security. The output of that good is $\gamma g \in [0, 1]$ (where $\gamma > 0$). For every level of self-protection by an individual producer and level of g provided by the ruler, each producer keeps the following share of his production away from bandits: $s(x + \gamma g)$ if $x + \gamma g \leq 1$; 1 if $x + \gamma g \geq 1$. (Note form the previous section that $s(1) = 1$.)

The question then becomes why would a producer ever engage in self-protection, given that self-protection takes away resources from production (as production equals $1 - x$). The reason is that the ruler does not just provide collective security through the hiring of guards out of the goodness of his heart, as the *Seven Samurai* or the *Magnificent Seven* might do. In addition to providing security against bandits, guards double up as enforcers in extracting tribute from producers. In particular, we assume that producers can keep away the same share of their production away from the ruler and his guards as they can keep away from bandits. We could expect at least some rulers to be able to extract more out of producers than bandits can but our qualitative results do not change without complicating the analysis unnecessarily.[6] Then, the tax rate, τ, received by the ruler is the difference between what is kept away from bandits and what producers can keep away from guards:

$$\tau = s(x + \gamma g) - s(x) \tag{5}$$

By increasing the number of guards the ruler automatically increases the tax rate, provided of course that $x + \gamma g \leq 1$.

Given than a ruler can extract the same amount as a bandit, a heathen producer's optimization problem is exactly the same as before and their choice of self-protection is the same as under anarch, x^*, so that their production is also the same as under anarchy, $1 - x^*$.

It is different, however, for a producer who is a believer. In particular, the ruler's status or prestige - and the personal contribution to that of the producer

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[6] Konrad and Skaperdas (2012) examine that case in the absence of believers in Big-God religion. Since rulers can extract more from producers than bandits can, self-protection is higher and production lower than in anarchy, rulers extract a higher share of production than bandits could, and overall welfare is lower than under anarchy.

- provides the producer with a psychological payoff.[7] This is also in accordance with "giving Caesar what belongs to Caesar." We therefore modify a believer's payoff so that he or she partly values the tax paid to the ruler:

$$U_{\mu p} = s(x)(1 - x) + \mu_p + \sigma\tau(1 - x) \text{ where } \sigma \in (0, 1)$$

Given that the tax rate partly depends on self-protection through (5), the payoff function of a believer producer is the becomes

$$U_{\mu p}(x) = [(1 - \sigma)s(x) + \sigma s(x + \gamma g)](1 - x) + \mu_p \qquad (6)$$

The optimal level of self-protection for a producer who is a believer and ascribes status to the ruler is lower than that under anarchy or of that of a heather producer.

Proposition 2: *Let $\sigma \in (0, 1)$ and let x^σ denote the optimal level of self protection of a producer who is a believer with the payoff function in (6). Then,*

(i) $x^\sigma < x^*$ and x^σ is decreasing in σ;

(ii) production of a believer producer $(1 - x^\sigma)$ is higher than that of a heathen producer $(1 - x^*)$ and is increasing in σ;

(iii) the material payoff of a producer who is a believer is lower than that of a heathen producer and is decreasing in σ as long as $x^\sigma < 1/2$.

(The proof is in the Appendix.)

By putting fewer resources into self-protection believer producers devote more resources to production but allow a greater share to the ruler and bandits. That is of advantage to the ruler. However, another advantage to the ruler is that he could potentially hire believers as guards at a lower cost than heathens because of part (iii) of the Proposition: Believer producers make less overall than heathen producers because they value what they give to the ruler, provided $x^\sigma < 1/2$. The latter condition is satisfied for sufficiently effective self-protection technologies. For example, the class of functions $s(x) = x^\alpha$ for $\alpha \in (0, 1]$ satisfies this condition. In fact, to facilitate analytical results and simplicity we will assume for the remainder of the paper that particular functional form with $\alpha = 1$.

Assumption A: $s(x) = x$

Under Assumption A, we have the following values for different variables of interest:

$$x^* = 1/2, 1 - x^* = 1/2, U_{hp} = s^*(1 - x^*) = 1/4$$

$$x^\sigma = \frac{1 - \sigma\gamma g}{2}, (1 - x^\sigma) = \frac{1 + \sigma\gamma g}{2}, x^\sigma(1 - x^\sigma) = \frac{1 - (\sigma\gamma g)^2}{4} \qquad (7)$$

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[7]For introducing such status payoffs in models, see Shayo (2009), Sambanis and Shayo (2013), and Sambanis et.al. (2015). For a rational-choice approach to religious authority, see McBride (2016). Konrad and Qari (2012) provide evidence of greater tax compliance for those who feel more patriotic.

The tax rate on both heathen and believer producers under assumption A turns out to be the same and equals γg. Perfect security against bandits occurs when $x + \gamma g = 1$. Guards can take values up to $\bar{g}$. We think of $\bar{g}$ as providing an upper limit on *state capacity.* Consistent with the literature on the topic (Besley and Persson, 2011, McBride et. al., 2011, Johnson and Koyama, 2017), we consider this upper limit to be fixed by past investments that typically take time to bear fruit. Since the maximum of security provided by the sum of the individual and the ruler cannot exceed 1, so that $x^* + \gamma\bar{g} \leq 1$ and, by Assumption A, $x^* = 1/2$, we must have $\gamma\bar{g} \leq 1/2$.

5   A Ruler with Believer Subjects

We now turn to examining the ruler's profit as a function of the fraction of believers $\beta \in [0, 1]$ under his rule, with the remainder of the subjects $(1 - \beta)$ as heathens. The timing is as follows:

1. The ruler hires g guards whom he can choose among both believers and heathens.

2. The remaining population $(1 - g)$ makes choices between becoming producers and bandits so that no producer has an incentive to become a bandit and no bandit has an incentive to become a producer.

Recall that the number of guards determines under Assumption A both the level of the public good γg that is partly protecting producers from bandits as well as the tax rate, also γg. The payoff of a heathen producer will be the same as under anarchy, which under Assumption A is $x^*(1 - x^*) = (\frac{1}{2})(\frac{1}{2}) = \frac{1}{4}$, whereas the payoff of a heathen bandit should be at least equal to that of a heathen producer; it would be strictly higher if there are no heathen producers.[8] Heathens hired as guards by the ruler will have to receive the going payoff for heathens which will be that of the producer (i.e., $\frac{1}{4}$). Also under Assumption A, the payoff of a believer producer is

$$\frac{1 - (\sigma\gamma g)^2}{4} + \mu_p + \sigma\gamma g \tag{8}$$

where the material part of the payoff is from (7). The payoff of a believer bandit will be at least as great as that of believer producer and there will be no believer bandits unless there are some believer producers. Moreover, because believer bandits have to pay a moral cost (μ_b) and the alternative payoff of being a producer in (8) includes both a moral payoff and the status payoff, there will be no believer bandits unless there are some heathen bandits (except for the limiting case when there are no heathens and $\beta = 1$). Believers hired as guards by the ruler enjoy the psychological payoffs of $\mu_p + \sigma\gamma g$ that believer producers

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[8]It is not possible to have the payoff of a heathen producer strictly as it is fixed by the amount of their production and self-protection effort.

have (in (8))[9] and therefore they only need to be paid $\frac{1-(\sigma\gamma g)^2}{4}$ in material payoff by the ruler (which is less than $\frac{1}{4}$, the payoff of heathen guards). Therefore, from the point of view of the ruler, believer guards are cheaper than heathen guards.

For given β, the number of guards and the types of guards chosen by the ruler determine how believers and heathens sort themselves between producers and bandits. The ruler's profits are as follows:

$$\pi_r = \nu_\mu(g)\gamma g\frac{1+\sigma\gamma g}{2} + \nu_h(g)\gamma g\frac{1}{2} - g_\mu\frac{1-(\sigma\gamma g)^2}{4} - g_h\frac{1}{4} \qquad (9)$$

where $g = g_\mu + g_h$, $\nu_\mu(g)$ is the induced number of believer producers, $\nu_h(g)$ is the inducer number of heathen producers, g_μ are the believer guards hired and g_h are the heathen guards hired. The first term includes the tax on each believer producer (γg) and the output of a believer producer ($\frac{1+\sigma\gamma g}{2}$) and similarly for the second term for heathen producers.

The types of outcomes in terms of who is hired as guard and who becomes producer or bandit depends on the number of believers relative to the number of heathens. The following Table summarizes the four intervals of $[0,1]$ as the number of believers becomes successively higher. (The values of β_0 and β_1 depend on the other parameters of the model and will be derived in due course.)

Range of β :	Believers (β) become:	Heathens ($1-\beta$) become:
$[0,g)$	All guards	Guards, producers, bandits
$[g,\beta_0]$	Guards and producers	Producers and bandits
(β_0,β_1)	Guards and producers	All bandits
$[\beta_1,1]$	Guards, producers, and bandits	All bandits

Table 1

For illustration about how we proceed in showing these types of outcomes, we begin with the first case whereby $\beta \in [0,g]$ (the results, other that some heathens become guards hold for $\beta = g$). There are fewer believers than guards to hire and therefore the ruler has the option of hiring all believers as guards with the rest of the guards to be hired will necessarily will have to be heathens. Believers are cheaper to hire than heathens but they also provide greater tax revenue than heathens ($\gamma g\frac{1+\sigma\gamma g}{2}$ vs. $\gamma g\frac{1}{2}$). However, the decision by the ruler whether to hire believers as guards or to let them choose to become producers is not a straight calculation between the extra tax revenue from a believer producer versus the cost savings from hiring the same believer as guard. The reason is that a believer producer is also more lucrative to bandits as bandits get both a bigger share ($\frac{1+\sigma\gamma g}{2} - \gamma g$ vs $\frac{1}{2} - \gamma g$) and a bigger target output ($\frac{1+\sigma\gamma g}{2}$ vs $\frac{1}{2}$) from a believer producer than from a heathen producer. That is, there is

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[9] It is also possible for guards to have higher psychological payoffs than producers as the ruler can motivate them with team and religious instruction that are normal higher than peasant producers. They could thus offer even lower material wages than those expected by believer producers. Of course, such a specification would make our results stronger than they are.

a significant "leakage" to bandits if the ruler were to have a believer become a producer, especially in the presence of heathen bandits, instead of hiring him as a guard.

It turns out that it is optimal for the ruler to hire all believers as guards when $\beta \in [0, g]$. (We show in the Appendix why having them turn into producers is not optimal for the ruler.) Given all β of the believers become guards, the rest of the guards are heathens, how do the remaining heathens distribute themselves between producers and guards? With the number of producers denoted by $p(= \nu_h(g))$ and that of bandits by $1 - p - g$, the payoff of heathen producer ($\frac{1}{4}$) must be equal to that of bandits:

$$\frac{1}{4} = (\frac{1}{2} - \gamma g)\frac{1}{2}\frac{p}{1 - p - g}$$

which yields

$$p = \frac{1 - g}{2(1 - \gamma g)}$$

The ruler's payoff (see (9)) then becomes:

$$\begin{aligned}
\pi_r(\beta \in [0, g]) &= \frac{1 - g}{2(1 - \gamma g)}\gamma g\frac{1}{2} - \beta\frac{1 - (\sigma\gamma g)^2}{4} - (g - \beta)\frac{1}{4} \\
&= \frac{g}{4}\frac{(\gamma - 1)}{(1 - \gamma g)} + \frac{\beta}{4}(\sigma\gamma g)^2
\end{aligned} \tag{10}$$

Note that this is strictly increasing in g and therefore the ruler would set it to its maximum current level of state capacity, $\bar{g}$. We summarize the main findings about the ruler's payoff as a function of the number of believers in the the following Proposition with its proof in the Appendix.

Proposition 3: *(i) For $\beta \in [0, \bar{g}]$, the ruler's payoff is strictly increasing in β;*

(ii) For $\beta \in (\bar{g}, \beta_0)$, where $\beta_0 = \frac{1 + g(1 + \sigma\gamma g - 2\gamma g)(1 + \sigma\gamma g)}{1 + (1 + \sigma\gamma g - 2\gamma g)(1 + \sigma\gamma g)}$, the ruler's payoff is strictly decreasing in β;

(iii) For $\beta \in [\beta_0, \beta_1]$, where $\beta_1 = \frac{1 + 4\mu + 4\sigma\gamma g - (\sigma\gamma g)^2 + g(1 + \sigma\gamma g - 2\gamma g)(1 + \sigma\gamma g)}{1 + 4\mu + 4\sigma\gamma g - (\sigma\gamma g)^2 + (1 + \sigma\gamma g - 2\gamma g)(1 + \sigma\gamma g)}$, the ruler's payoff is strictly increasing in β;

(iv) For $\beta \in (\beta_1, 1]$ the ruler's payoff is constant at its level at β_1.

The population of subjects among the different occupations is distributed as in Table 1.

Figure 2 about here

Figure 2 shows how the a Big-God ruler's profit varies with the share of believers under his rule. The ruler's profit is higher than a heathen's one (assumed to be the one where $\beta = 0$) at low enough and high enough levels of β. For intermediate levels of β, a Big-God ruler can have a slightly lower profit than a

heathen one; those are the levels at which there is too much "leakage" to bandits from believer producers.[10] At low levels of believers (below $\bar{g}$) the ruler solely benefits by having to spend less on guards because believer guards require lower material compensation since they also derive moral and status payoffs as believers. It would not benefit the ruler to have believers become producers as they would present a more lucrative target to bandits than heathen producers are. In intermediate ranges of β ($\in (\bar{g}, \beta_0)$), the addition of believer producers induces more heathens to become bandits to the extent that they reduce both the total number of producers and the ruler's payoff. Only when there are enough believers so that heathens become bandits exlusively (at and beyond $\beta = \beta_0$) new believers increase one-for-one by the amount of tax of the ruler's payoff. When there are plentiful enough believers (beyond $\beta = \beta_1$) so as to present lucrative enough targets even for believers, do the extra believers become bandits. Then, over that range, any heathen bandit is replaced by a believer who also becomes a bandit. That critical level β_1 can increase, so that more believers become producers, when the moral payoffs of believers ($\mu = \mu_p + \mu_b$) increase.

Mature Big-God rulers do have a high proportion of believers, and have actively campaigned for their expansion. There have also been dynamic Big-God rulers who initially had a limited number of believers, such as in early Islam, in which the believers were limited to specialists in violence, as it is in the model.

It should be emphasized that essentially all the material benefits from the publicly provided security (through γg) are captured by the ruler as profits. Heathens have the same payoffs as under anarchy,[11] except when there are few enough heathen producers who co-exist with believer producers (that is , for $\beta > \beta_1$). In fact, believers receive a lower material payoff than under anarchy as they are compensated by the psychological status payoff from valuing the ruler's revenue.

Note that morality does not play a role in increasing the ruler's profits except in increasing the level of β_1 and, therefore, having profits increase as β increases when $\beta \leq \beta_1$. Furthermore, all extra economic benefits in the model come from the increased security and the fewer resources devoted to self-protection by believer producers. There is no trade that could benefit from both the increased economic activity due to higher security and the easier contract enforceability when a greater proportion of the population consists of believers with moral preferences. To accommodate such considerations, we could modify the model in the following manner: Let $A(y, \beta\mu)$ be an increasing function of the total output in the economy (y) and of the average morality in the economy ($\beta\mu$).

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[10] That could, of course, be potentially reduced or elminated if the Big-God ruler were to provide it greater protection to believer producers than heathen producers but that might seem arbitrary from a modeling and substantive viewpoint.

[11] This is partly due to the simplifying assumption that producers - either heathens or believers - can resist the ruler and his guards as easily as they can bandits. Making it harder for producers to resist the ruler can be expected to increase resources by producers expended on self-protection and reduce production. This is not necessarily better for the ruler as it could reduce total tax revenue. See Konrad and Skaperdas (2012) for such modeling without the psychological payoffs we have in this paper.

With $A(y, \beta\mu) > 1$ for $y > \bar{y}$ for some $\bar{y}$ and $\beta\mu > 0$, it can be a coefficient that multipies all material payoffs (in an analogous manner to the A in the Ak model of endogenous growth theory - see Aghion and Howitt, 1997). Then, as output increases as a result of having more security and more believer producers (who produce more than heathen producers) as well as having higher average morality that enhances contract enforcement, the effects of an increasing β would be higher for the ruler's profits but also for overall output as well.

6   Investing in Big God

> In the twenty-five years between his victory [over Maxentius] and his death, Constantine ordered a sequence of huge church buildings, from Rome to the Holy Land. All were built largely at the Emperor's expense. This deluge of Christian publicity exceeded any other programme in precious stone which was realized by a ruler in antiquity...
> ... In Spring 313, Constantine wrote again to the pagan governor of North Africa, exempting the clergy of the recognized Catholic Church from the burdens of civic office.... The Christian prayers, said Constantine, were intimately connected with the safety of the state.   Lane Fox (1988, p. 623)

Religious variations start organically that usually fulfill local and specialized needs that can grow or fizzle out in competition with other variations. In the Roman Empire Christianity was one of many competing variations of both Big-God religions and traditional pagan ones. When Emperor Constantine converted to Christianity, no more than 5 percent of Rome's population has been estimated to have been Christian and the countryside had almost none of them (Lane Fox, 1988, Ch.6). Moreover, there was not one version of Christianity even then, as Arianism was a major competitor to what turned out to be the Catholic Orthodox version after the Council of Nicaea in 325, which took place under the watchful eye of the Emperor. Christianity became the state religion of the Roman Empire and all European states that came to existence afterwards. Emperors, Kings, and the aristocracy built churches, endowed monasteries, sponsored the clergy and gave them privileges, punished pagans and heretics, and tried to evangelize the heathen countryside.

All this took significant economic resources but both spreading and maintaining the salience of Big God in people's everyday lives requires continual reminders (Norenzayan, 2013). We can think of these expenditures as investments on the part of rulers that ultimately increase their profits.[12] In terms of our model, the investments can be both at the extensive margin (by increasing

---

[12]Of course, building a church that might take more than one's lifetime (as it has routinely occurred) requires an especially long-term horizon that extends the notion of profitablity to include a dynasty, while still not being inconsistent with genuine belief on the part of the ruler who undertakes such a project.

the share of believers β) and at two intensive margins, by increasing the status parameter σ or the morality parameter μ. Evangelizing missionaries are mostly operating at the extensive margin; having a village church and priest, regular mass and Sunday school operate at the intensive margins. There is, however, some complementarity between the two margins and we can assume there is joint cost function of investments $c(I_\beta, I_\sigma, I_\mu)$ where I_β, I_σ, and I_μ are investments in β, σ, and μ. To ensure interior solutions, the cost function has to be strictly convex and to allow for positive investments when there are positive marginal benefits to an investment we can assume $\frac{\partial c}{\partial I_i}_{I_i \to 0} = 0$ for $i = \beta, \sigma, \mu$. Furthermore, we assume there are increasing functions and concave functions of each investment so that $\beta = \beta(I_\beta), \sigma = \sigma(I_\sigma)$, and $\mu = \mu(I_\mu)$.

It can be helpful to consider the incentives for investments on the part of a rulers at different levels of β. Consider first the case of $\beta \in [0, \bar{g}]$ in which the profit of the ruler is as in (10). Note that there is no incentive to invest in morality in this case as μ does not appear in the ruler's profit but there is an incentive to invest in the two other cases. In particular the conditions for investments in β and σ are as follows:

$$
\begin{aligned}
\frac{\beta'(I_\beta^g)}{4}(\sigma\gamma\bar{g})^2 &= \frac{\partial c(I_\beta^g, I_\sigma^g, 0)}{\partial I_\beta} \\
\frac{\beta}{2}\sigma'(I_\sigma^g)\sigma(\gamma\bar{g})^2 &= \frac{\partial c(I_\beta^g, I_\sigma^g, 0)}{\partial I_\sigma}
\end{aligned}
\tag{11}
$$

Recall that all newly converted believers in that case become guards and the main benefit to the ruler is to persuade them of his own status and prestige so that they can accept lower material compensation than a heathen ruler provides. There is no point in investing in morality as there are not enough believers in danger of becoming bandits that would reduce the ruler's profits. There are also complementarities between the marginal benefits of investing in these two, as a greater σ increases the marginal benefit of investing in β and a greater β increases the marginal benefit of investing in σ.[13] This is case of a Big-God religion that is confined to an elite and its specialists in violence such as the Achaemenid Persian empire under Zoroastrianism, the Islam of the early conquests, or the early Frankish kingdoms in Gaul.

For the case of $\beta \in (\bar{g}, \beta_0)$ the ruler's payoff is decreasing in β and there is no incentive in investing in β or in the intensive margin aspects of the religion unless there can be sufficient increase in the share of believers so as to leapfrog to β beyond β_0. For that case, the ruler's payoff is (see Appendix):

$$
\pi_r(\beta \in [\beta_0, \beta_1]) = (\beta - g)\gamma g\frac{1 + \sigma\gamma g}{2} - g\frac{1 - (\sigma\gamma g)^2}{4}
$$

---

[13]State capacity $\bar{g}$ also increases both marginal benefits and investing in state capacity would also be complementary with the two investments. This complementarity with state capacity does not unambiguously extend in the other cases we examine below.

and the optimality conditions for investments are the following (still with $I_\mu^0 = 0$):

$$\beta'(I_\beta^0)\gamma g \frac{1+\sigma\gamma g}{2} = \frac{\partial c(I_\beta^0, I_\sigma^0, 0)}{\partial I_\beta}$$

$$\frac{2(\beta-g)(\gamma g)^2 + \gamma^2 g^3}{4}\sigma\sigma'(I_\sigma^0) = \frac{\partial c(I_\beta^0, I_\sigma^0, 0)}{\partial I_\sigma} \quad (12)$$

Assuming linear or a not-too-concave functions $\beta = \beta(I_\beta)$ and $\sigma = \sigma(I_\sigma)$, the marginal benefits of investments in (12) are considerably higher than in (11) and would therefore induce correspondingly higher investments than in the first case. This would be the era of the mass spread of monasteries, churches, and missionaries by rulers that would have liked to replace heathen producers with more pliable believer producers. Once, however, the share of believers reaches β_1 the incentives for investment change. Recall that beyond β_1 the number of producers and the ruler's profits remain at the same level. β_1 itself, though, depends on μ and σ (see Proposition 3(iii)). Without going into the details because of the large number of terms, the incentives for the ruler are to invest in morality, status, and for increases in β just up to β_1. This is the era of consolidation and institutionalization of Big God as essentially a monopoly state religion, with church or mosque or temple being a vital center of community life and believers tightly embedded within it. Bandits could conceivably be eliminated or marginalized enough to be driven away.

7   Concluding Remarks

In addition to increasing rulers' profits Big Gods have had the side-effect of increasing economic activity. This is consistent with Olson's (1993) intuition that a ruler who behaves as a *stationary* bandit perhaps unintentionally improves the economy. Morality and norms help directly with economic exchange and the ruler's legitimacy improves tax collection and production. That appears to be the case for pre-modern states and their economies, but how much can we extend these effects of Big Gods to modern states and economies? Much of modern economic activity takes place in markets with anonymous buyers and sellers and exchange is often impersonal, requiring formal property rights. Morality and norms are not sufficient for impersonal exchange and constitutionally unconstrained rulers have difficulty commiting to property rights (North et.al, 2009). Moreover, the modern nation-state's legitimacy is not based on Divine Will but popular sovereignty and the idea of citizenship. Likewise, national identification is the primary identification of citizens, not religious identification (although national identification is sometimes based on religious identification). Morality and norms are still relevant, however, and the effects of long-ago established states within a modern state's boundaries has been argued (Wimmer, 2018) to be an important factor in successful modern economic development. How the legacy of older Big-God states affects modern growth is unclear and worthy of closer investigation.

APPENDIX

Proof of Proposition 1: Part *(i)*: Let $\beta \in [0, s^*]$ and suppose, as stated in the proposition, all believers become producers and heathens distribute themselves between producers and bandits. The latter would imply that the payoffs of heathens are equalized so that

$$U_{hb}(p^*) = (1 - s^*)(1 - x^*)\frac{p^*}{1 - p^*} = s^*(1 - x^*) = U_{hp}$$

which implies that, in such a case, the unique solution for p^* is $p^* = s^*$. Given this equilibrium number of producers the payoffs of a believer producer and a believer bandit would be related as follows: Thus, a believer bandit would achieve a payoff strictly lower than that of a producer and therefore a believer could not be a bandit in equilibrium. All believers become producers and since there are $\beta(\leq s^*)$ of them, the rest of the producers $(s^* - \beta)$ must be heathens. The remainder heathens $(1 - s^*)$ must become bandits, with the same payoff as producers. This configuration of proportion of producers (and bandits) and payoffs satisfy the conditions for an anarchic equilibrium.

To show uniqueness, suppose another equilibrium exists with a number of producers $p' \neq p^*$. Given that $p^* = s^*$ uniquely solves $U_{hb}(p^*) = U_{hp}$, the other equilibrium must have $U_{hb}(p') \neq U_{hp}$. There are then two possibilities.

First, we could have $U_{hb}(p') > U_{hp}$ or that $(1 - s^*)(1 - x^*)\frac{p'}{1-p'} > s^*(1 - x^*) \implies p' > s^*$. Moreover the inequality in heathen payoffs, by the definition of equilibrium, implies than no heathens would become producers - all would become bandits so that $b' = 1 - p' \geq 1 - \beta$ or that $p' \leq \beta$ where $\beta \in [0, s^*]$ and thus $p' \leq s^*$, contradicting $p' > s^*$ in the previous sentence. Therefore, no other equilibrium can exist in this case.

Second, we could have $U_{hb}(p') < U_{hp}$ or that $(1 - s^*)(1 - x^*)\frac{p'}{1-p'} < s^*(1 - x^*) \implies p' < s^*$. This inequality of heathen payoffs, by the definition of equilibrium, implies that no heathens would become bandits - all would become producers. In addition, the following

$$
\begin{aligned}
U_{\mu p} &\equiv s^*(1 - x^*) + \mu_p > \\
&> s^*(1 - x^*) > (1 - s^*)(1 - x^*)\frac{p'}{1 - p'} > \\
&> (1 - s^*)(1 - x^*)\frac{p'}{1 - p'} - \mu_b = U_{\mu b}(p') \text{ given that } \mu_p > 0 \text{ and } \mu_b > 0
\end{aligned}
$$

imply $U_{\mu p} > U_{\mu b}(p')$ or that all believers would also become producers, thus leading to $p' = 1$, a contradiction to the multiplicity of equilibria. Therefore, no other equilibrium can exist in this case as well and the equilibrium is unique.

Part *(ii)*: Let $\beta \in [s^*, \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}]$. Then, $p^* = \beta$ satisfies $U_{\mu p} \equiv s^*(1 - x^*) + \mu_p \geq (1 - s^*)(1 - x^*)\frac{p^*}{1-p^*} - \mu_b = U_{\mu b}(p^*)$ and therefore it is consistent with all believers becoming producers. Moreover, $p^* = \beta$ implies $U_{hb}(p^*) = (1 - s^*)(1 - x^*)\frac{p^*}{1-p^*} > s^*(1 - x^*) = U_{hp}$ and therefore consistent with will

heathens becoming bandits so than $b^* = 1 - p^* = 1 - \beta$. Since all conditions satisfy the equilibrium conditions $p^* = \beta$ is an equilibrium.

To show uniqueness, suppose another equilibrium $p' \neq \beta$. If $p' > \beta$, then at least some producers must be heathens which, in turn, implies $U_{hb}(p') = (1 - s^*)(1 - x^*)\frac{p'}{1-p'} > s^*(1 - x^*) = U_{hp}$. This contradicts the equilibrium condition for a heathen to be a producer. Thus, cannot have $p' > \beta$.

If $p' < \beta$, then at least some believers must be bandits. However, we would then have

$U_{\mu p} \equiv s^*(1-x^*)+\mu_p \geq (1-s^*)(1-x^*)\frac{\beta}{1-\beta} - \mu_b > (1-s^*)(1-x^*)\frac{p'}{1-p'} - \mu_b = U_{\mu b}(p')$ contradicting the equilibrium condition that believer bandits should be having at least as high a payoff as believer producers.

Therefore no equilibrium other than $p^* = \beta$ exists.

Part *(iii)*: Let $\beta \in [\frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}, 1]$. Having believers become both producers and bandits would equate the payoffs of the two professions so that $U_{\mu p} \equiv s^*(1-x^*) + \mu_p = (1-s^*)(1-x^*)\frac{p^*}{1-p^*} - \mu_b = U_{\mu b}(p^*)$, which implies $p^* = \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$. Then, $U_{hb}(p^*) = (1-s^*)(1-x^*)\frac{p^*}{1-p^*} > (1-s^*)(1-x^*)\frac{p^*}{1-p^*} - \mu_b - \mu_p = s^*(1-x^*) = U_{hp}$, which implies that no heathens can be producers as required by the equilibrium. Thus, the conditions for the equilibrium described are satisfied.

To show uniqueness, suppose another equilibrium $p' \neq \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$. If $p' > \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$, then we would have $\qquad U_{\mu b}(p') = (1-s^*)(1-x^*)\frac{p'}{1-p'} - \mu_b > s^*(1-x^*) + \mu_p = U_{\mu p}$

as well

$U_{hb}(p') = (1-s^*)(1-x^*)\frac{p'}{1-p'} > (1-s^*)(1-x^*)\frac{p'}{1-p'} - \mu_b - \mu_p = s^*(1-x^*) = U_{hp}$

which imply that neither believers nor heathens would choose to become producers, a contradiction.

If $p' < \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$, then we would have

$U_{\mu b}(p') = (1-s^*)(1-x^*)\frac{p'}{1-p'} - \mu_b < s^*(1-x^*) + \mu_p = U_{\mu p}$

which implies than no believers can be bandits and all believers must be producers. But then, since the number of believers $\beta \geq \frac{s^*(1-x^*)+\mu}{(1-x^*)+\mu}$, we have $\beta > p'$ or that the number of believers is greater than the number of producers, a contradiction.

Therefore the equilibrium must be unique in this case as well.

Proof of Proposition 2: Part *(i)*: Note that
$x^\sigma = \text{argmax}_x U_{\mu p}(x) = [(1 - \sigma)s(x) + \sigma s(x + \gamma g)](1 - x) + \mu_p$
Differentiation of (6) yields
$\frac{\partial U_{\mu p}(x)}{\partial x} = [(1 - \sigma)s'(x) + \sigma s'(x + \gamma g)](1 - x) - [(1 - \sigma)s(x) + \sigma s(x + \gamma g)]$
Since $s(x)$ is strictly concave, we have $s'(x) > s'(x + \gamma g)$ for all x and $\gamma g > 0$. Therefore, we have:
$[(1 - \sigma)s'(x) + \sigma s'(x + \gamma g)] < s'(x)$
Moreover, since $s(x) < s(x + \gamma g)$ we also have
$[(1 - \sigma)s(x) + \sigma s(x + \gamma g)] > s(x)$

The last two inequalities imply

$\frac{\partial U_{\mu p}(x^*)}{\partial x} = [(1-\sigma)s'(x^*)+\sigma s'(x^*+\gamma g)](1-x^*)-[(1-\sigma)s(x^*)+\sigma s(x^*+\gamma g)] < s'(x^*)(1-x^*) - s(x^*) = 0$

with the last equality sign following from the optimality condition of a heathen producer (or a believer producer with $\sigma = 0$).Then, for $x^\sigma \in (0,1)$, we must have

$\frac{\partial U_{\mu p}(x^*)}{\partial x} < 0 = \frac{\partial U_{\mu p}(x^\sigma)}{\partial x}$

Given that $s''(x) < 0$, we can readily show that $\frac{\partial^2 U_{\mu p}(x)}{\partial x^2} < 0$. We must then have $x^\sigma < x^*$ as stated in the Proposition.

By totally differentiating the first-order condition we can readily show that x^σ ius decreasing in σ.

Part *(ii)*: The stated properties of $1 - x^\sigma$ readily follow from the properties of x^σ.

Part *(iii)*: The material payoff of a producer who is a believer is $x^\sigma(1-x^\sigma)$. Then, we have

$\frac{\partial x^\sigma(1-x^\sigma)}{\partial \sigma} = \frac{\partial x^\sigma}{\partial \sigma}(1 - x^\sigma) - x^\sigma\frac{\partial x^\sigma}{\partial \sigma} = \frac{\partial x^\sigma}{\partial \sigma}(1 - 2x^\sigma) < 0$ if $x^\sigma < 1/2$ as stated in part (iii) of the Proposition.

Proof of Proposition 3: Part (i): We have shown before the statement of the Proposition the derivation of the ruler's payoff function under the assumption that all believers are hired as guards. It remains to be shown that this yields a higher payoff than hiring solely heathens for guards and having all believers become producers. Suppose, then, that all believers do become producers and all guards are heathens. In that case, the number of producers consists β believers and $p' - \beta$ heathens (with the latter receiving a payoff of $\frac{1}{4}$) and the payoff of heathen producers and bandits equalized by the following equation:

$$\frac{1}{4} = \frac{\beta(\frac{1+\sigma\gamma g}{2} - \gamma g)\frac{1+\sigma\gamma g}{2} + (p' - \beta)(\frac{1}{2} - \gamma g)\frac{1}{2}}{1 - p' - g}$$

which yields the following number of producers:

$$p' = \frac{1 - g}{2(1 - \gamma g)} - \beta\frac{\sigma\gamma g(2 + \sigma\gamma g - 2\gamma g)}{2(1 - \gamma g)}$$

Note that the number of producers in this case (when all believers become producers instead of guards) to the number of producers when all believers become guards (derived in the equation before (9)) is lower by the second term that is negative. This is the greater "leakage" of output, mentioned in the main text, when believers become producers. The difference in the number of producers is equivalent to having more bandits which translates into lower profits for the ruler. In particular, given p', the ruler's payoff is:

$$\pi'_r(\beta \in [0,g]) = \beta\gamma g\frac{1 + \sigma\gamma g}{2} + [\frac{1 - g}{2(1 - \gamma g)} - \beta\frac{\sigma\gamma g(2 + \sigma\gamma g - 2\gamma g)}{2(1 - \gamma g)}]\gamma g\frac{1}{2} - g\frac{1}{4}$$

$$= \frac{g}{4}\frac{(\gamma - 1)}{(1 - \gamma g)} - \frac{\beta\sigma^2(\gamma g)^3}{4(1 - \gamma g)}$$

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This payoff is clearly strictly lower than $\pi_r(\beta \in [0, g])$ in (10) and the appropriate one for $\beta \in [0, \dot{g}]$. Moreover, since this payoff is strictly increasing in g, the optimal choice of g is $\bar{g}$.

Part (ii): Let $\beta \in (\bar{g}, \beta_0)$. By the arguments made in the text and in the proof of part (i), all guards should be believers with the rest becoming producers (as all bandits are heathens and no believer has an incentive to become a bandit when there are sufficiently high numbers of heathens). That is, believer producers number $\beta - g$. (Note that we allow for any g because, although it is optimal for a ruler to have $g = \bar{g}$ when $\beta \leq \bar{g}$, we have yet to show that is optimal for $g > \bar{g}$.) Heathens become producers and bandits until the number of believers becomes sufficiently large so that no heathens choose to become producers. This sufficiently large number of believers is β_0 and is derived by equating the payoff of a heathen bandit when all producers are believers to the payoff of a heathen producer or

$$\frac{(\beta_0 - g)(\frac{1+\sigma\gamma g}{2} - \gamma g)\frac{1+\sigma\gamma g}{2}}{1 - \beta_0} = \frac{1}{4}$$

which yields the β_0 stated in the Proposition.

To determine the ruler's payoff function for that range of βs, we need to determine the number of producers p" and bandits from the following equality of heathen payoffs between bandit and producer:

$$\frac{(\beta - g)(\frac{1+\sigma\gamma g}{2} - \gamma g)\frac{1+\sigma\gamma g}{2} + [p" - (\beta - g)](\frac{1}{2} - \gamma g)\frac{1}{2}}{1 - p" - g} = \frac{1}{4}$$

which yields a p" which is analogous to p' above:

$$p" = \frac{1 - g}{2(1 - \gamma g)} - (\beta - g)\frac{\sigma\gamma g((2 + \sigma\gamma g - 2\gamma g)}{2(1 - \gamma g)}$$

By using this number of bandits in the ruler's payoff we eventually obtain:

$$\begin{aligned}\pi_r(\beta \in (\bar{g}, \beta_0)) &= (\beta - g)\gamma g\frac{1 + \sigma\gamma g}{2} + [p" - (\beta - g)]]\gamma g\frac{1}{2} - g\frac{1 - (\sigma\gamma g)^2}{4} \\ &= \frac{g}{4}\frac{(\gamma - 1 + (\sigma\gamma g)^2)}{(1 - \gamma g)} - \frac{\beta\sigma^2(\gamma g)^3}{4(1 - \gamma g)}\end{aligned}$$

which is strcitly decreasing in β, as stated in the Proposition.

Part (iii) Let $\beta \in [\beta_0, \beta_1]$. Over that range of βs, β_1 is defined so that the payoff of a believer producer just equals the payoff of believer bandit. That is,

$$\frac{(\beta_1 - g)(\frac{1+\sigma\gamma g}{2} - \gamma g)\frac{1+\sigma\gamma g}{2}}{1 - \beta_1} - \mu_b = \frac{1 - (\sigma\gamma g)^2}{4} + \mu_p + \sigma\gamma g$$

where the left-hand side is the believer bandit's payoff and the right-hand side is the believer producer's payoff. (Note that the believer producer's payoff is always greater than $\frac{1}{4}$, the heathen producer's payoff, and therefore heathen bandits must be receiving a higher payoff than $\frac{1}{4}$ as well.) The β_1 defined in

the Proposition is the unique solution from this equation. Then, in the range between β_0 and β_1 all bandits are heathens and any new believers become producers, replacing one-for-one the heathen bandits. Thus, as β increases, the ruler gains the tax revenue from the extra producers without any cost. The payoff of the ruler is as follows

$$\pi_r(\beta \in [\beta_0, \beta_1]) = (\beta - g)\gamma g \frac{1 + \sigma\gamma g}{2} - g \frac{1 - (\sigma\gamma g)^2}{4}$$

which is strictly increasing in β with a slope of the extra tax revenue $\gamma g \frac{1+\sigma\gamma g}{2}$.

Part (iv) Let $\beta \in (\beta_1, 1]$. Beyond β_1, all extra believers become bandits - every new believer replaces a heathen bandit. That is, over that range the number of producers is fixed at $\beta_1 - g$ and therefore the profits of the ruler do not change with changes in β and are constant at:

$$\pi_r(\beta \in (\beta_1, 1]) = (\beta_1 - g)\gamma g \frac{1 + \sigma\gamma g}{2} - g \frac{1 - (\sigma\gamma g)^2}{4}$$

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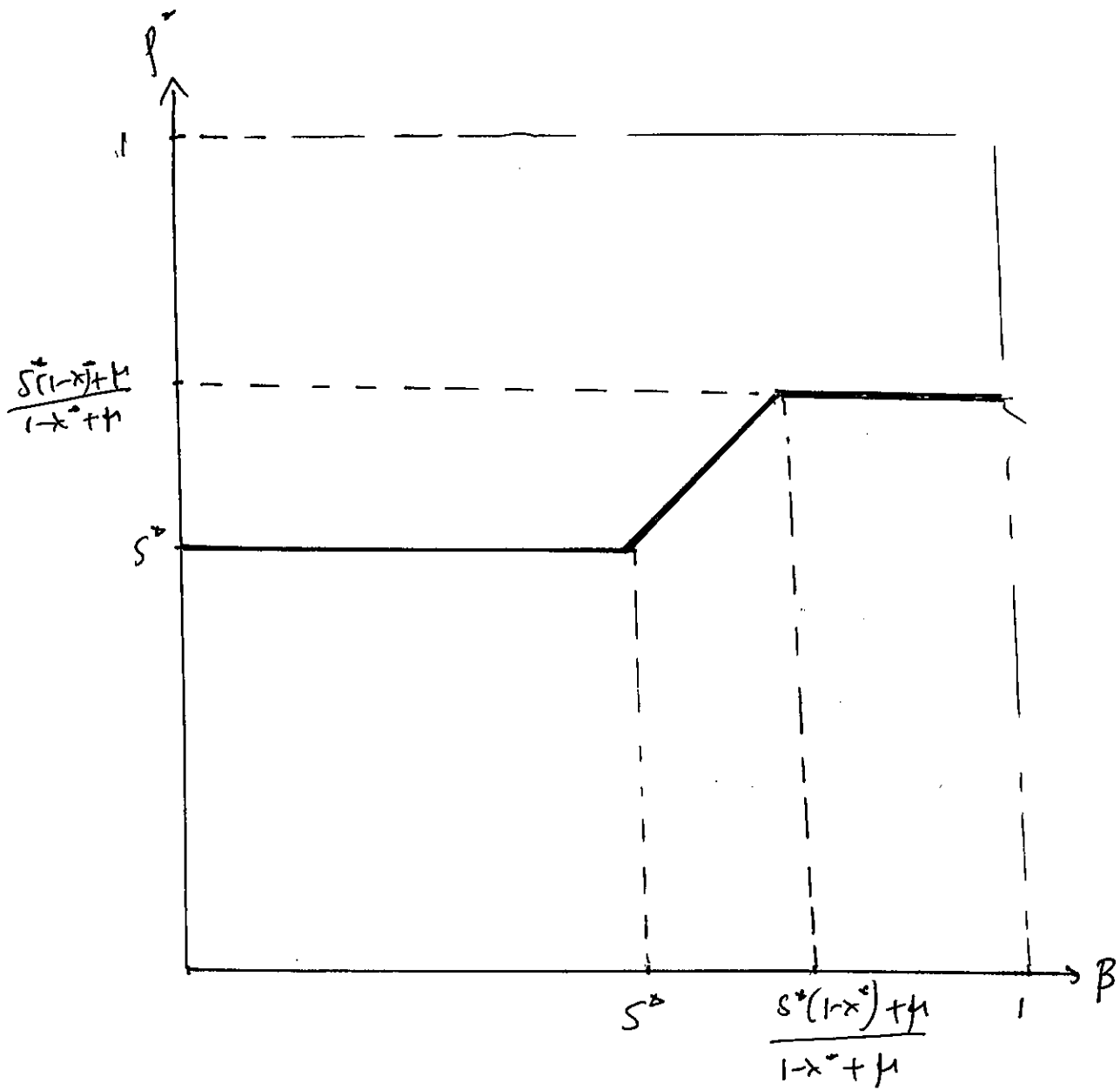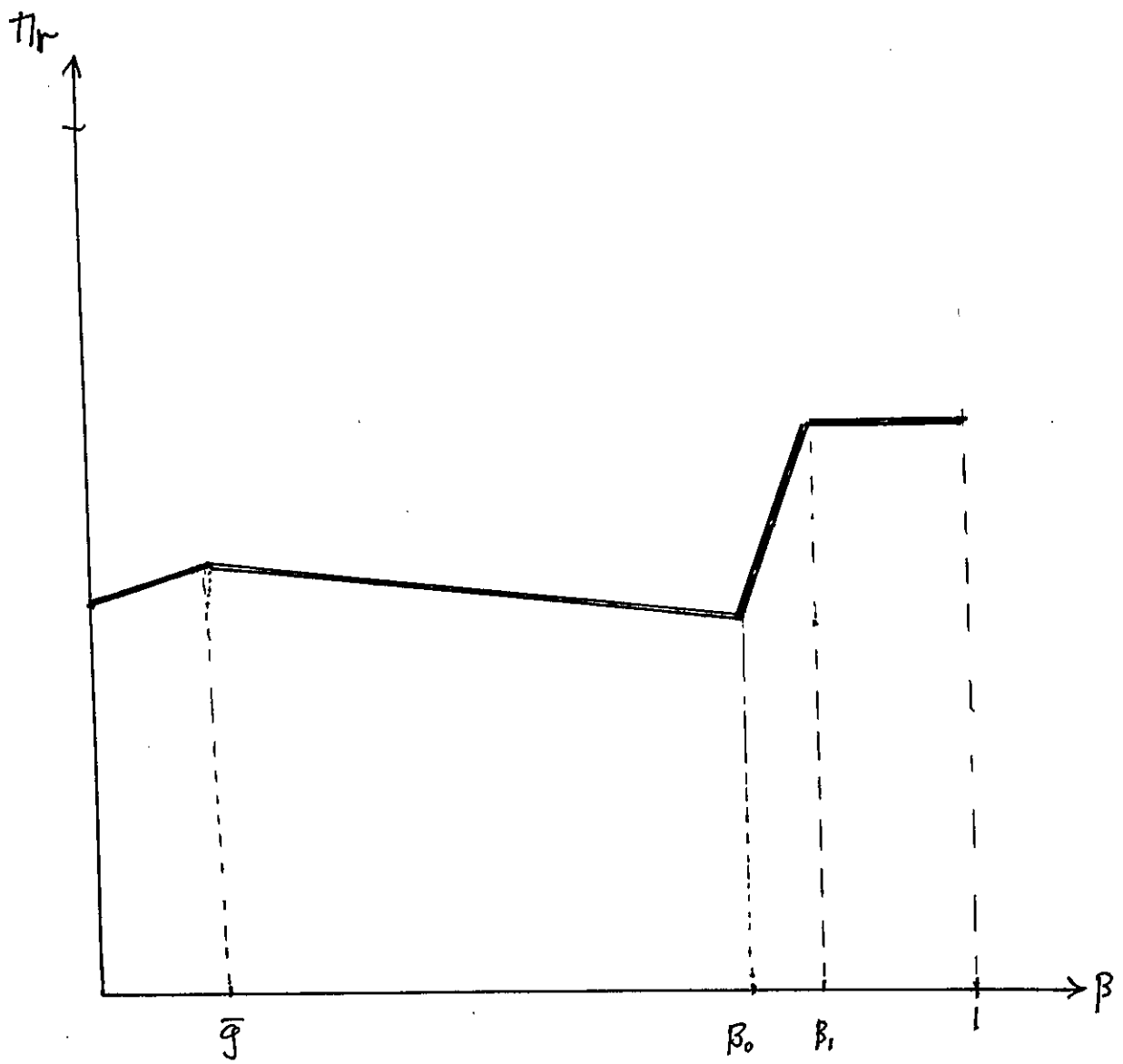[47] Wintrobe, Ronald, *The Political Economy of Dictatorship,* 1998, New York: Cambridge University Press.

Figure 1: Production under Anarchy

Figure 2: Ruler's Profits