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The Evolution of Sectarianism and the Collapse of Human Reciprocity and Cooperation

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The tendency of humans to cooperate for reasons other than self-interest has long intrigued social scientists, leading to a substantial literature in recent years. However, this question has a complement which has only received closer attention in the political science literature. In sectarian societies, we frequently observe that individuals do not cooperate even in cases which are beneficial at the individual and group level. In this paper, I study the principal drivers for sectarianism and the dynamics that undermine cooperation by developing an evolutionary game theoretic and agent-based model. Much in the same way as in models of cooperation, the interrelation of actions, preferences and institutions can lead to a co-evolution of sectarian identities. Supporting the constructivist perspective, the model demonstrate in which way the history of interaction, external exertion of influence, and internal non-sectarian inequalities and conflicts are key to explaining the tendency for religious bigotry and hostility.

Keywords: Sectarianism, Cooperation, Religious Conflict, Evolutionary Theory

1 Introduction

The evolution of cooperation has received much scientific attention during the past two decades and has brought together economists, anthropologist, and sociologists.[1] On the other hand, its antithesis - sectarianism - has not been studied in the same detail, and the evolutionary basis remains understudied across the social sciences. It remains heavily debated by political scientists, while economists have mostly ignored sectarianism, despite sectarian conflict having a persistent significant political and socio-economic impact on most regions in the world. The Spanish Civil

[1] The editors of Science ranked cooperation as one one of the top 25 questions facing scientists today (Pennisi, 2005).

War, the Lebanese Civil War, the Yugoslav Wars, the Rwandan Genocide, and the Syrian Civil War are only but a few examples of sectarian-driven conflicts since the past century. Sectarian societies forgo opportunities of mutually advantageous exchange and cooperation between members of different religious affiliations while sectarian conflict is harmful both at a group and an individual level.[2] Understanding the roots of sectarianism and sectarian conflict can thus fundamentally improve our understanding of human cooperation.

This paper will explore the factors leading to sectarianism and sectarian conflict, using analytical tools from evolutionary game theory and agent-based modelling. Although its theoretical model does not take account of the individual characteristics of sectarianism in different regions, it is able to replicate the predominant characteristics of sectarianism and sectarian conflict. The model demonstrates a co-evolution of seemingly ideological fronts along sectarian borders, and socio-economic and political powers. Religious affiliation is shown not to be the cause of sectarianism but to serve as its crucial descriptive characteristic. Thus contrary to common perception, but supported by the literature (e.g. Barr, 2011; Makdisi, 2000; Salloukh et al., 2015), the model shows that sectarianism and sectarian conflict are not driven by religious ideologies. Sectarianism is rooted in and reinforced by social and economic grievances, as well as internal weaknesses and instabilities and in some cases, by imposed inequalities linked to a group's cultural identity (for a broad overview of both the specific reasons and the general properties, see Hashemi and Postel, 2017). Sectarian conflict does not only have social and economic consequences, it is, in fact, caused by socio-economic factors. Consequently, the paper emphasises the need to study sectarianism across the social sciences. Adding to existing literature, this paper provides a general understanding of how the general factors determine the evolutionary forces behind *sectarianisation*.

2 Literature and Context

Sectarianism has been extensively studied by political scientists, and in recent years, especially in the Middle Eastern context. Recent in depth analyses of the region are provided by Hashemi and Postel (2017) and Wehrey (2017). A good overview of the historical context in the Middle East is provided in Barr (2011), while Salloukh et al. (2015); Salibi (2014); Makdisi (2000), offer detailed analysis of the specific context of Lebanon. These authors are part of a modern interpretation of sectarianism that disagrees with other historical explanations (e.g. Nasr, 2006; Lewis, 1997) following a *primordial* or *instrumentalist* perspective, which are especially common in popular scientific literature. The primordial, instrumentalist, and constructivist perspectives are not homogeneously defined in the literature and tend to conflated and intermix (for a critical study, see Tilley, 1997). Yet, in the context of sectarianism, the former primordial perspective is frequently based on a historical explanation postulating that religious conflict fuelled by instinctive impulses, innate social characteristics ancient or *perceived* social givens (on the latter, see especially Geertz, 1973), and reinforced by tribal blood feuds for one and a half millennia has organically shaped and reinforced a cultural predisposition to violence. As such, sectarianism and sectarian conflict are deeply rooted in the social relations of sectarian societies defined by

[2]See, for example, the fatwas forbidding Sunnis to eat meat slaughtered by Shi'as or the marriage between both sects.

inevitable and lasting perpetual sectarian differences. Instrumentalism (e.g. Fearon and Laitin, 2000; Lake and Donald, 1998; Taylor and Yapp, 1979), on the other hand, postulates that sectarian and ethnic conflict are externally created and reinforced by state and political actors who construct identities to advance their political and economic interests by emphasising on in-group similarities and out-group differences. This paper provides strong support for a mixed approach - the *constructivist* perspective - which recognises the significance of pre-determined (and potentially imagined) differences in ethnic or religious identities, but also the changing character of these identities and perceives them as not inevitably driving a social system into conflict. Active manipulation by leaders, elites, and external actors play a critical role in the mobilisation process. Religious identities take on the role of markers of evolving socio-economic cleavages.

Since the study of sectarianism is a natural extension of the study of cooperation, existing models on cooperation are therefore a fertile basis for developing analytical models on sectarianism. Sociobiology studies the evolution of social behaviour within species via natural selection (e.g. Wilson, 1975), and offers a wide plethora of models (Hamilton, 1975; Keller, 1999; Wade, 1978; Wilson, 1980). In social systems, fitness based replication is substituted by (biased) cultural transmission (see Cavalli-Sforza and Feldman (1973); Dawkins (1976); Popper (1979) and especially, Boyd and Richerson, 1988, 2005a). However, models of cooperation frequently assume small populations defined by simple and recurrent interactions, where either detrimental actions against a group lead to a punishment of the specific individual perpetrator or behaviour that may not be beneficial for an individual is supposed to be beneficial for a group as a whole. These conditions do not generally hold in sectarian societies.

While economists have not studied sectarianism, some economists have examined ethnic conflict which is functionally analogous to sectarianism. However, literature discussing the theoretical underpinnings of intra-state ethnic conflict (e.g. Esteban and Ray, 2011) frequently assumes an underlying segregation and hostility between groups *ex ante* while relying on some version of the contest model. In these models, contest occurs only at the group level, often reduced to two uniform groups, i.e., rebels and government (other examples are Haavelmo, 1954; Hirshleifer, 1988, 1989; Garfinkel, 1990; Grossman, 1991; Skaperdas, 1992 and for a broader overview, see Garfinkel and Skaperd, 2007; Blattman and Miguel, 2010), thus disregarding the co-evolution of conflict and ethnic divide. Other literature focuses on collective actions and free-riding (for further elaboration, see Tullock, 2005; Weinstein, 2005) as well as the principal motivators (grievance vs. greed debate, see Collier and Hoeffler, 2004; Keen, 2012), the role of individual incentives and social sanctions (for the impact of these effects on intra-state conflict, see Humphreys and Weinstein, 2008). Similarly, the multi-dimensionality of sectarianism requires that a proper study does not focus on religious or ethnic fault lines alone, but includes the socio-economic institutional framework. A number of scholars illustrate that ethnicity is instrumentalised for economic and political competition (Bates, 1983; Fearon, 2005; Chandra, 2004). The feedback between political and economic power and sectarian conflict is therefore an essential element in understanding the evolutionary dynamics underlying sectarianism. This renders the paper more akin to the literature focusing on the co-evolution of institutions and culture (e.g. Belloc and Bowles, 2013; Bisin and Verdier, 2015; Bowles, 2004; Bowles and Gintis, 2011; Boyd and Richerson, 2005b; Levine and Modica, 2012).

Identity is another essential constituent of sectarianism. While identity economics (Akerlof and Kranton, 2010) fails to explain crucial characteristics of religious groups (for a discussion,

see Ille, 2017), it forms a theoretical basis for studying the connections between group identification (e.g., perceived in-group similarity and out-group dissimilarity) and the internalization of ideals and norms (Akerlof and Kranton, 2002; Bernheim, 1994).[3] Identity influences preferences and decisions, determines power relations and social interactions, and creates a sense of belonging (Horst et al., 2009). It explains characteristics of sectarianism, such as status effects (Veblen, 2009) and public actions (Granovetter, 1978), upholding norms and retaliation against norm violators (Fehr and Gächter, 2000), as well as ostracism of outsiders and favouritism of insiders (Sherif et al., 1961). Identity formation simultaneously feeds on and causes sectarianism.

This literature includes two models that serve as a starting point for this research. The model by Choi and Bowles (2007) illustrates the conditions necessary for the evolution of ostracism and group conflict, as well as discriminatory (or parochial) altruism in the presence of unconditional altruism. The system's dynamics are determined by a biological selection process that operates simultaneously at an intra- and inter-group level. The model can be easily adapted to the given context by adjusting the migration rate, the replication process, and the frequency of interaction. While such an extension of Choi and Bowles (2007) can explain a number of properties of sectarian conflict (such as the co-evolution of parochial behaviour and conflict), the model's dynamics are fundamentally affected by group size. In larger group sizes, parochial and altruistic traits do not persist in the long-run. The model can therefore not explain sectarianism in larger societies. In contrast, the model in Axtell et al. (2001) is based on a Nash demand game, similar to the one used here, and provides an intuition for the occurrence of in-egalitarian and discriminatory institutions, while being unaffected by population and group size. However in this model, institutional change occurs by chance and institutions are generally efficient. Instead of providing a strong rational of the underlying dynamics, individuals coordinate either on an egalitarian or in-egalitarian equilibrium out of an ergodic process and a coincidental sequence of interactions. The model thus falls short of explaining the coercive nature of sectarianism that leaves potential for free-riding, as well as the inefficiency created by sectarian conflict.

On the basis of a simple model, I study both the evolution of sectarianism and sectarian conflict. In the absence of a clear definition in the literature, I define the former as a form of social contract that attributes socio-economic privileges and political rights among a population based on the adherence to a specific religious sect. The latter is then defined as a violent contestation of this social contract. Following the constructivist perspective, neither sectarian identities nor sectarian conflict are assumed to exist a priori, but are an evolving property determined by the history of interactions and practice between individuals. I focus on the conditions necessary for the evolution of sectarianism and the mutual re-enforcement of its characteristics. Since sectarian affiliation only serves as a signal for the distribution of rights and privileges, I study under which condition a discriminatory marker defining an individual's position in a socio-economic contract emerges that is linked to sectarian affiliation. I further analyse the factors supporting an endogenous evolution of the coercive nature of sectarianism, which enforces abidance to a sectarian social contract, as well as the drivers of conflict in a sectarian society.

The following section elaborates the baseline model that will provide a general understanding of the systems' dynamics based on a closed-form solution. This model provides a baseline, which I extend in section 4 to provide a fuller understanding of the underlying dynamics of

[3] See also social identity theory (Goffman, 1959).

sectarianisation and sectarian conflict. Section 5 interprets the theoretical results, compares them with empirical findings and concludes.

3 The model with no sect and two sects

To start, assume that individuals are not part of a sect and all members of the population are randomly matched in pairs to play a simplified Nash demand game with three possible strategies. The demand game is thereby representative of the determination of a general social contract in which individuals demand an arbitrary set of political rights or socio-economic powers. Each player l can choose a pure strategy $s_l \in S = \{L, M, H\}$, where L stands for demanding low equivalent to 25%, M for medium equivalent to 50%, and H for high equivalent to 75%. Obtaining a larger share is in the interest of each individual since it translates into more rights and power, yet should the joint demands of both matched players exceed 100%, no social contract is formed and both will receive nothing. The payoffs are then as defined in matrix 1.

$$\begin{array}{c} \\ \mathbf{L} \\ \mathbf{M} \\ \mathbf{H} \end{array} \begin{array}{c} \begin{array}{ccc} \mathbf{L} & \mathbf{M} & \mathbf{H} \end{array} \\ \begin{pmatrix} 0.25, 0.25 & 0.25, 0.50 & \mathbf{0.25,0.75} \\ 0.50, 0.25 & \mathbf{0.50,0.50} & 0, 0 \\ \mathbf{0.75,0.25} & 0, 0 & 0, 0 \end{pmatrix} \end{array} \tag{1}$$

The three Nash equilibria are shown in bold. A *socially efficient* outcome occurs if the joint net gains from exchange are equal to 1. All three Nash equilibria are socially efficient, but only (M, M) is egalitarian.[4]

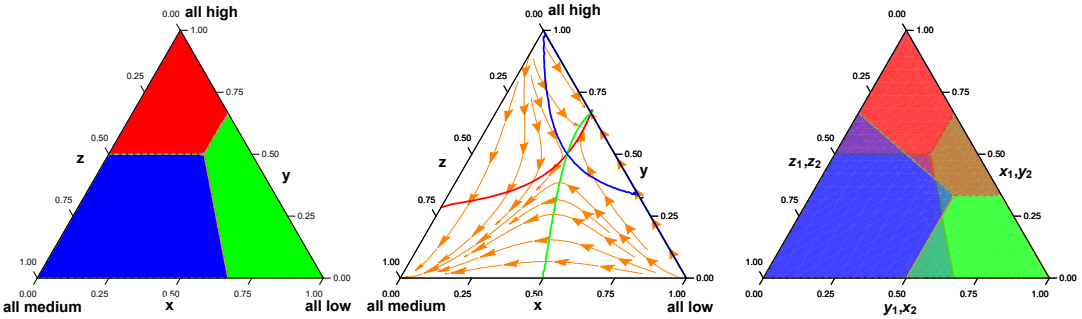
I define x as the frequency of L-players, y as the frequency of H players and $z = 1 - x - y$ as the frequency of M-players. Interactions are defined by one-shot games, i.e. both players can only make one offer. Since each player does not know what his counterpart will demand, he can only choose a strategy based on the likelihood of encountering a player choosing a given pure strategy. In the absence of segmentation, the likelihoods equal the frequencies in the population. Since all frequencies add up to 1, any population distribution can be defined by the tuple (x, y) in the unit simplex represented as an equilateral triangle. Figure 1a represents the unit simplex where the coloured area demonstrates a players best response given a population distribution. The best response to any point in the green area is H, in the blue area is M, and in the red area is L. Assuming that interactions take place regularly over time and players update their strategy by comparing their own payoffs to the payoffs that others generate during these interactions, the changes for our population frequencies can be modelled by the following replicator equation

$$\dot{x} = x(\pi_x - \phi) \tag{2a}$$

$$\dot{y} = x(\pi_y - \phi) \tag{2b}$$

[4]Note that the equilibria are identical under the assumption that the inegalitarian outcomes are socially inefficient (e.g. by defining the pay-offs as 0.7 for H and 0.2 for L in outcomes (L, H) and (H, L)). The reason for excluding this assumption is here to focus on social efficiency caused by coordination failures, instead of confounding both sources of inefficiency. The following results are unaffected by this assumption and also hold if a small dead-weight loss occurs at inegalitarian / sectarian social contracts.

Figure 1: Unit simplices for the 3 Strategy Nash Demand Game



(a) Best response areas, no sect (b) Dynamics with isocurves red: $\dot{x} = 0$, green: $\dot{y} = 0$, blue $\dot{z} = 0$ (c) Superimposed best response areas, 2 sects

where π_x and π_y define the expected payoff for choosing strategy L and H, respectively, and $\phi = x\pi_x + y\pi_y + z\pi_z$ defines the average payoff in the population. In other words, whenever a strategy does better (worse) than the average, its frequency increases (decreases). Figure 1b illustrates the dynamics. The population converges either to an *all M state* or a state in which $1/3$ of the population chooses L and the rest chooses H.

Now, assume that two sufficiently large subpopulations (i.e. sects) of size n exist. I can then equivalently define the replicator equations for the frequencies in each sect, indicating the corresponding subgroup by a subscript. The equilibria of this game are given by any distribution at which no change in the population frequencies occurs, i.e., at $\dot{x}_1 = \dot{x}_2 = \dot{y}_1 = \dot{y}_2 = \dot{z}_1 = \dot{z}_2 = 0$. However, the long-run evolving properties of this model are of greater interest. Individuals are prone to commit errors and to rarely but recurrently choose a strategy that is not their best response. Evolutionary stable states (ESS) are unaffected by this kind of idiosyncratic play, as long as it occurs sufficiently infrequently. This game has three evolutionary stable states, namely $\{x_1 = 1, y_1 = 0, x_2 = 0, y_2 = 1\}$, $\{x_1 = 0, y_1 = 0, x_2 = 0, y_2 = 0\}$, and $\{x_1 = 0, y_1 = 1, x_2 = 1, y_2 = 0\}$.[5] Thus in the long-run, the population finds itself in an equilibrium (i.e. a social contract) that is either egalitarian or in which sectarian affiliation serves as a marker that assigns either a high or low share to an individual. The reason becomes clear by looking at the mutual best response strategies, which is illustrated in Figure 1c. While keeping the original colour coding of 1a) for sect 1, I inverted the colour code for sect 2. For sect 2, L is the best response in the green area, M in the blue area, and H in the red area. Figure 1c superimposes the unit simplex for sect 2 on the unit simplex for sect 1. While primary colours thus define mutual-best response areas, secondary colours thus illustrate a mismatch. The red area indicates the mutual best response of L for sect 1 and H for sect 2, the blue area indicates the mutual best response of M both for sect 1 and sect 2, and the green area indicates the mutual best response of H for sect 1 and L for sect 2. Each of these best-response areas defines the basin of attraction for each respective ESS defined by simplex vertices. Also, each of the three ESS is socially efficient.

[5] Stable equilibria are defined by those frequency tuples at which all eigenvalues of the system's Jacobian matrix have only negative real parts. Solving for all frequencies equal to zero, defines 16 different equilibria of which only the mentioned three are stable.

In addition, players are assumed to choose to coerce other players into accepting their offer. Therefore, in addition to choosing a strategy between strategies low, medium, and high, they can be of one of two types: either coercive (indicated by superscript c in the following) or acquiescent (indicated by superscript a).[6] While an acquiescent type behaves according to the regular Nash Demand game, a coercive type imposes herself on the other player with the help of the other coercive members in his sect if joint demands exceed 1. Thus, success of the coercive measure depends on the abundance of coercive players in sect 1 and 2. Let the type frequency of coercive members in sect $i = \{1,2\}$ interacting with a member of sect $j = \{1,2\}$, $i \neq j$ be defined by α_i. I assume the following probabilities for a successful coercion.

- If the other player acquiesces, he will succeed with probability α_i.
- If the other player is also coercive and $\alpha_i > \alpha_j$, he will succeed with probability $\frac{1}{2} + \frac{\alpha_i - \alpha_j}{2}$,
- and if $\alpha_i < \alpha_j$, he will succeed with probability $1 - \left(\frac{1}{2} + \frac{\alpha_j - \alpha_i}{2}\right) = \frac{1}{2} + \frac{\alpha_i - \alpha_j}{2}$.

All probabilities extend over the entire unit interval, but include the possibility of a member in a sect with fewer other coercive members to decide the conflict in her favour. If the member succeeds, she receives her highest possible payoff of 0.75 and receives a payoff of zero otherwise. Since the inferior party receives a payoff of 0 instead of 0.25, any coercive action constitutes a socially inefficiency outcome.[7] However, each time a player loses, all his supporters pay a cost. Given the winning probabilities, a player of sect i loses an encounter with probability

$$\eta_i = (1-\alpha_j)(1-\alpha_i) + \alpha_j \left(\rho_{\alpha_i > \alpha_j} \left(1 - \frac{1 + \alpha_i - \alpha_j}{2} \right) + \rho_{\alpha_j > \alpha_i} \frac{1 + \alpha_j - \alpha_i}{2} \right) \tag{3}$$

where ρ is an indicator function that takes on a value of 1 if the condition in the subscript is true and 0 otherwise. The share of encounters at which joint demands exceed 1 and a member is coercive in sect i are given by

$$\zeta_i = \alpha_i (z_i y_j + y_i z_j + y_i y_j) \tag{4}$$

Further assume that each unsuccessful encounter results in a loss of[8]

$$\sigma_i = \kappa \frac{\bar{\pi}^h}{\pi_k^h} \tag{5}$$

which is shared among all sect members given by $\alpha_i n$, i.e., cost consists of a constant κ and a weighing factor, which is the ratio of $\bar{\pi}^h$ defining the average pay-off of the population, and

[6] In general, *type* refers to being coercive or acquiescent, whereas *strategy* refers to choosing to demand low, medium or high.

[7] Furthermore, the reader might argue here that a player should only impose his original demand and not the maximum of 0.75. However, in order to be consistent, I should then assume that the cost of coercion is also dependent on the original demand. This will unnecessarily complicate the model without adding much to its explanatory power.

[8] For convenience, I assume that each individual has a strictly positive payoff after history h. In all simulations, the appropriate costs have been chosen to guarantee the assumption.

π_k^h, defining the pay-off of a member k after the history of play h. This represent the superior ability of politically and economically more successful individuals to impose their conditions. Expected cost of being coercive is then

$$\gamma_i = n\zeta_i\eta_i \frac{1}{\alpha_i n}\sigma_i = \frac{[2-(2-\alpha_j)\alpha_i-(1-\alpha_j)\alpha_j]\,[(1-x_i)\,y_j+y_iz_j]\,\sigma_i}{2} \tag{6}$$

The expected payoffs for all 6 strategy-type combinations for sect i is given by

$$\pi_{xi}^a = 0.25 \tag{7a}$$
$$\pi_{yi}^a = 0.75x_j \tag{7b}$$
$$\pi_{zi}^a = 0.50(x_j+z_j) \tag{7c}$$
$$\pi_{xi}^c = 0.25-\gamma_i \tag{7d}$$
$$\pi_{yi}^c = 0.75(x_j+(y_j+z_j)\left[(1-\alpha_j)\alpha_i+\alpha_j\frac{1+\alpha_i-\alpha_j}{2}\right]-\gamma_i \tag{7e}$$
$$\pi_{zi}^c = 0.50(x_j+z_j)+0.75y_j\left[(1-\alpha_j)\alpha_i+\alpha_j\frac{1+\alpha_i-\alpha_j}{2}\right]-\gamma_i \tag{7f}$$

Consequently, being coercive and choosing strategy L is strictly dominated, since it will always be better to acquiesce instead. In addition, defining $\omega_i = 0.75(\alpha_i(2-\alpha_j)+(1-\alpha_j)\alpha_j)$ and $\eta_i = (2-\alpha_i(2-\alpha_j)-(1-\alpha_j)\alpha_j)\sigma_i((1-x_i)y_j+y_iz_j)$, the surplus for being a coercive type is $(\omega_i y_j-\eta_i)/2$ for an M player and $(\omega_i(1-x_j)-\eta_i)/2$ for an H player. In relative terms, the former therefore benefits from the presence of H players, whereas the latter benefits from the absence of L players. This is intuitive, since being a coercive type can only be attractive in the presence of a frequent failure of exchange at the demanded conditions. In addition, if $\alpha_i = 1$ strategy L is strictly dominated, while strategy H dominates M for $x_j < 1$, $\alpha_1 = 1$ and $\alpha_j < \sqrt{8/3}/2$. If a sect is entirely coercive, no member will demand a low share and all its members will ask for a high share, if the other sect is not too coercive itself and not all of the latter's members demand low. Figure 2 shows the mutual best-response equilibria if the coercive type takes over one or both sects: the equilibria are defined by $s_1 = H, s_2 = L$ for $\alpha_1 = 1, \alpha_2 = 0$, $s_1 = M, s_2 = M$ for $\alpha_1 = 1, \alpha_2 = 1$, and $s_1 = L, s_2 = H$ for $\alpha_1 = 0, \alpha_2 = 1$.

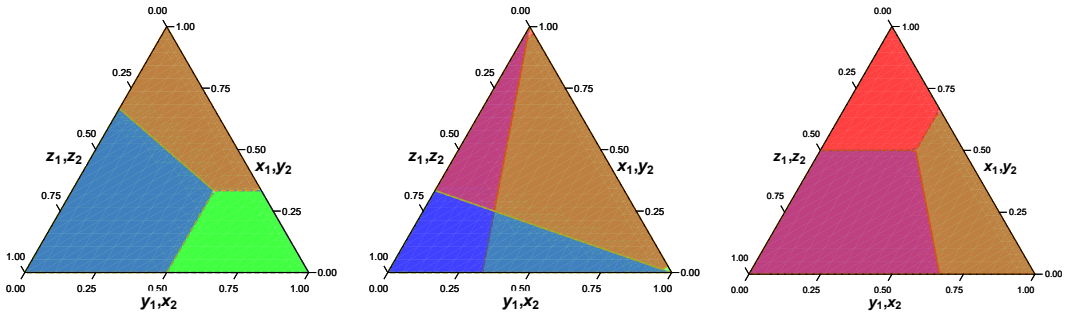
The dynamic system is then defined by 3 equations for each sect i

$$\dot{x}_i = x_i\left[((1-\alpha_i)\pi_{xi}^a+\alpha_i\pi_{xi}^c)-\bar{\pi}\right] \tag{8a}$$
$$\dot{y}_i = y_i\left[\left((1-\alpha_i)\pi_{yi}^a+\alpha_i\pi_{yi}^c\right)-\bar{\pi}\right] \tag{8b}$$
$$\dot{\alpha}_i = \alpha_i(1-\alpha_i)(\bar{\pi}_i^c-\bar{\pi}_i^a) \tag{8c}$$

with $\bar{\pi} = x_i\left[(1-\alpha_i)\pi_{xi}^a+\alpha_i\pi_{xi}^c\right]+y_i\left[(1-\alpha_i)\pi_{yi}^a+\alpha_i\pi_{yi}^c\right]+z_i\left[(1-\alpha_i)\pi_{zi}^a+\alpha_i\pi_{zi}^c\right]$, and for the coercive type frequency $\bar{\pi}_i^c = x_i\pi_{xi}^c+y_i\pi_{yi}^c+z_i\pi_{zi}^c$, and $\bar{\pi}_i^a = x_i\pi_{xi}^a+y_i\pi_{yi}^a+z_i\pi_{zi}^a$. Setting all six equations in 8 to zero and solving the system of equations, I obtain three asymptotically stable strategy equilibria in the unit interval.[9] These evolutionary stable equilibria are identical to

[9] The system of equations 8 cannot be solved simultaneously. I therefore solved the first 4 equations for the strategies 8a and 8b independent from the remaining two equations for the type frequency $\dot{\alpha}_1 = \dot{\alpha}_2 = 0$. Note that solving

Figure 2: Unit simplices with coercive players (same colour coding as Figure 1c)



(a) Best response for $\alpha_1 = 1, \alpha_2 = 0$ (b) Best response for $\alpha_1 = 1, \alpha_2 = 1$ (c) Best response for $\alpha_1 = 0, \alpha_2 = 1$

the three equilibria obtained in the simpler case without types, but are subject to the following conditions

$\{x_i = 1, y_i = 0, x_j = 0, y_j = 1\}$ only stable if:

$$\alpha_i < \frac{\frac{1}{2}\left(\alpha_j^2 - \alpha_j\right) + \sqrt{\frac{1}{4}\left(\alpha_j - \alpha_j^2\right)^2 - \frac{2}{3}\alpha_j + \frac{4}{3}}}{2 - \alpha_j} \tag{9a}$$

$\{x_1 = 0, y_1 = 0, x_2 = 0, y_2 = 0\}$ only stable if for both $i, j = (1,2), i \neq j$:

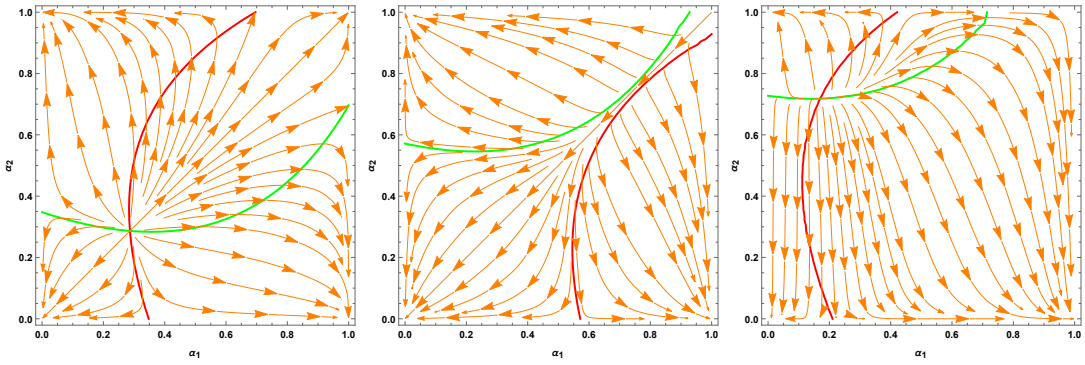
$$\alpha_i < \frac{\frac{1}{2}\left(\alpha_j^2 - \alpha_j\right) + \sqrt{\frac{1}{4}\left(\alpha_j - \alpha_j^2\right)^2 - \frac{4}{3}\alpha_j + \frac{8}{3}}}{2 - \alpha_j} \tag{9b}$$

In the former two equilibria, members discriminate according to a signal based on sectarian affiliation, while the latter equilibrium is non-discriminatory. I will therefore refer to an equilibrium as defined by 9a as a sectarian contract, and to an equilibrium defined by 9b as an egalitarian contract. All equilibria are neutrally stable with respect to the type frequencies and are therefore subject to random drift.[10] All equilibria are stable if $\alpha_1 = \alpha_2 = 0$, but only the

only for the type frequencies, I obtain that equilibrium $\alpha_1, \alpha_2 = 0$ (all acquiesce) is asymptotically stable if not all members in neither sects choose strategy L(or neutrally stable otherwise), while equilibrium $\alpha_1, \alpha_2 = 1$ (all coerce) is stable if one of the sects includes some H players and the other some M players. The non-symmetric equilibria $\alpha_i = 0, \alpha_j = 1$(one sect acquiesces whereas the other coerces), for $i, j = \{1,2\}$ and $i \neq j$, is stable if some members of the coercive sect choose M. Equilibria with $x_i = 1$ and $y_i, y_j = 0$ are neutrally stable, whereas equilibria of the type $\alpha_i = 1, \alpha_j = \frac{2\sigma_j}{0.75+\sigma_j}$ are unstable.

[10] Note that for the sectarian contract, the upper bound of coercive members of the sect playing low depends on the share of coercive players in the sect demanding high, and is strictly increasing for approximately $\alpha_j > 0.217$ and has a maximum upper bound of $\sqrt{8/3}/2$. Similarly in the egalitarian contract, the upper bounds of both type frequencies are defined by the share of coercive members in the respective other sect, yet can span the entire unit interval if the share of coercive players is sufficiently high, while the minimum upper bound is equal to the maximum upper bound of the sectarian contract.

Figure 3: Dynamics of a and b for various values of σ_1 and σ_2.



(a) $\sigma_1 = 0.4, \sigma_2 = 0.4$ (b) $\sigma_1 = 1.0, \sigma_2 = 1.0$ (c) $\sigma_1 = 0.2, \sigma_2 = 2.0$

egalitarian contract remains stable if $\alpha_1 = \alpha_2 = 1$, while only the sectarian contracts are stable for $\alpha_j = 1$ and $\alpha_i = 0$. Notice that both α_1 and α_2 are symmetric with respect to the strategy frequencies (i.e., $\dot{\alpha}_i(x_i, y_i, x_j, y_j) = \dot{\alpha}_i(x_j, y_j, x_i, y_i)$) and that the out-of-strategy-equilibrium behaviour is defined by the cost of an unsuccessful coercive attempt as defined by equation 5, but not the strategy frequencies. Consequently, the dynamics and equilibria for the type frequencies α_1 and α_2, as well as their basins of attraction, depend exclusively on the size of σ_1 and σ_2. Figure 3 provides an example for a rate of idiosyncratic play at $\varepsilon = 10^{-10}$.

Figure 3 shows in which way a decrease in σ_1 and σ_2 shifts the interior equilibrium to the origin, while an increase in both values shifts the interior equilibrium in the direction of $\alpha_1, \alpha_2 = 1$. Without any prior history of interactions and prior external influence, given a completely random initial sequence of interactions (i.e. before any social contract has been established), average pay-off of two comparable sects will be identical to $\sigma_i = \kappa$ for both $i = 1, 2$ and will lead to an egalitarian contract. The egalitarian contract is unaffected by the prevalence of one type over the other, but at small costs of coercion, rare idiosyncratic play leads the population to converge to a state in which all members are coercive, while sufficiently high costs lead to a state in which all individuals acquiesce. Yet for cases as in figure 3c, idiosyncratic play is likely to push a population to the sectarian contracts. This may be caused by an *ex ante* disparity in economic or social power, reflected by a difference between π_1^h and π_2^h. Sectarian contracts are thus self-stabilising. For example, for $(x_1 = 0, y_1 = 1, x_2 = 1, y_2 = 0)$ it eventually holds that $\bar{\pi}_1^h \gg \bar{\pi}_2^h$ and thus, $\sigma_2 \gg \sigma_1 \simeq 0.5\kappa$. This increases the basin of attraction of both $(\alpha_1 = 1, \alpha_2 = 2)$ (see figure 3c) and $(x_1 = 0, y_1 = 1, x_2 = 1, y_2 = 0)$ (see figure 2a).

Thus, the two sect case allows us to obtain an intuition for the co-evolution of types, strategies, and the prevalent social contract. A sectarian society is likely to evolve if one sect is significantly more coercive than the other, which can be caused by a difference in the cost of coercion, by a discrepancy in economic or political powers or by external exertion of influence. If both sects are initial defined by similar characteristics, the pervasive social contract will be egalitarian. In this contract, rigid prosecution of the egalitarian norm (i.e. most members are coercive) will be prevalent if these can be easily enforced, while high costs lead to an egalitarian contract with only few coercive members. Once a population settles on an egalitarian contract, only exogenous

changes to the ability and the cost of coercion for one sect in conjunction with idiosyncratic actions can destabilise the equilibrium and lead to the evolution of a sectarian contract.

4 Extensions

In its current form, the model takes account of the limited cognitive abilities of individuals, since both strategy and type choice are defined on the basis of social learning. However, the model ignores the historical component of *sectarianisation* and thus, the impact of past experience on individual decision-making. Strategic choice is shaped by experience of which actions were successful in the past. This experience may be partly individual and partly collective (Hashemi and Postel, 2017).

Akin to the literature on fictitious play with limited recall, assume that a member l of sect i has a memory of size m and recollects the last history of interactions with sect members of sect j. Thus, each time l makes a new experience with a member of i, she forgets the oldest interaction and adds the latest interaction to her memory. Member l does not know with whom she will be matched nor the strategy that will be played against her, but only the sect j of her counterpart. She assumes the likelihood with which the latter chooses a strategy is defined by the empirical frequency distribution of past play with sect j. She then chooses a strategy that maximises her expected pay-off.[11] Hence for example, if an individual observes that members of sect i sufficiently frequently demand L, her best response in the current period is to choose H.

If both strategies exceed a joint demand of one, and coercion is successfully attempted by one sect, the winning member recollects that the losing sect played L and correspondingly, the losing members recollects that the winning sect played H. If no contest occurs or no winner is determined (i.e., the coercion has been unsuccessful), both parties retain the other's original offer. In this type of fictitious play, a player takes account of the type distribution in a limited rational manner and not directly in a excessively cognitively demanding way that a recollection of the share of supporting coercive members for each period would require, but by remembering which strategy was successful at the end of the interaction.

I further assume that members regularly update their types by comparing their success over the past n periods to another sect member (for simplicity and without significant impact on simulation results as long as $n \approx m$, I assume $n = m$). This can be done in the way as defined by the previously defined replicator dynamics, but also in various other ways which I will define below. In addition, in some of these social learning encounters, the *student* does not only adopt the type of the *teacher*, but also the latter's recollection of past interactions. Depending on the relative frequency of this event with respect to the length of memory m, individuals weigh higher either collective or individual memory. In the most extreme case in which social imitation and an adoptions of a teacher's past history occurs in each period, an individual bases her choice exclusively on the teacher's memory. As long as members are randomly matched, a homogenisation of past experience into a collective memory should occur within the sect over time. If a

[11] In other words, given the history of the m last interactions as defined by pure strategy-tuple $s_{lj} = \big(s_j(t), s_j(t-1), \ldots, s_j(t-m+1)\big)$, let $\eta_l^t(s_j) : S_j \to \mathbb{N}$ be the frequency that l observed a member of sect j playing strategy s_j in the past m interactions. Given the player's pay-off function $\pi_l : S \to \mathbb{R}$, player l assumes the likelihood of this strategy in period t is then $\mu_l(s_j) = \eta_l^t(s_j)/m$ and chooses $s_l \in \arg\max_{s_l \in S_l} \pi_l(s_l, \mu_l)$.

player never embraces her teacher's past experience, choice is exclusively based on individual experience.

By separating an individual's determination of her strategy from her type, I implicitly incorporate a form of multi-level selection into the model. The strategy choice is based on an individual's interactions with the other sect (i.e., it is subject to inter-sectarian selection), while the type is defined based an encounters with and in comparison to members of the same sect (i.e., subject to intra-sectarian selection). At the same time, I also take account of the interplay between individual experience and collective memory. In the following, I will analyse the robustness with respect to four different replication dynamics. In each period, a share $\tau \in (0,1)$ of members of sect i follows one of the following replication variants and

1. adopt the type of the best performing sect member in that period and with probability $\zeta \in [0,1)$, the latter's past memory (*Variant 1*).

2. are randomly paired, while one member adopts the role of student k, the other of teacher l. If the teacher performs strictly better, the students adopts the teachers type with probability $\theta(\pi_k, \pi_l) \in (0,1)$ proportional to the pay-off difference $\pi_k - \pi_j$ and in this case, the latter's past memory with probability ζ (*Variant 2*).[12]

3. are randomly paired, and type and past memory is imitated as in Type 2, but the teacher is not randomly drawn from the entire sect, but from a predefined peer-group within the sect i (*Variant 3*).

4. are randomly paired, and type and past memory is imitated as in Type 2, but adoption may even occur if the pay-off difference is negative, such that $\theta(\pi_k, \pi_l) \in (0,1) > 0.5$ ($\theta(\pi_k, \pi_l) \in (0,1) < 0.5$) if student k performs worse (better) than teacher l (*Variant 4*).[13]

4.1 Simulation Results

All simulations show that attainable equilibria and time to converge to an equilibrium are invariant to changes in groups size. Consistent with this, the peer group size relative to the entire sect's population has an insignificant impact on the likelihood of the final equilibrium. In the first set of simulations, the initial stage is defined by a state in which no social contract has yet been determined. Consequently, each member of the two sects has a memory of past play of length m drawn from a random distribution of all three strategies at the initial state of the simulations. In addition, the same share of members is initially coercive for both sects. I therefore initialise each simulations from a completely random initial state identical for both sects.

If social learning is defined by variant 2 to 4, the population converges to the egalitarian contract defined by the set of equations 9b in each simulation run. Extensive simulations show that this result is robust to changes in the length of memories m and n, the share of members open to social learning τ, and the relative importance of the collective memory ζ. In addition,

[12] Note that this form of replication is closest to the one modelled by the replicator dynamics, see Weibull, 1997

[13] See Boyd and Richerson, 1992 for the underlying replicator dynamics

the cost of coercion κ does not affect results, even if it is not identical for both groups.[14]

If both sects are not initially equally coercive, a convergence to the egalitarian contract is not guaranteed. Simulations in which one sect is initially composed of only 1 per cent coercive members while the other sect consists of 99 per cent coercive members converge to an egalitarian contract in only one third of all runs, while in 64 per cent of the time, the population settled in a sectarian contract defined by the set of equations 9a. The initially highly coercive sect demands H and the acquiescent sect L. This is consistent with our previous analytical results. In only 3 per cent of all simulations, the population remained in a social inefficient state of mis-coordination after 1.000 periods of interaction. Model 1 in Table 1 illustrates the impact of all parameters that statistically significantly affect the likelihood of the egalitarian contract for replication variant 2 to 4.[15] Therefore, a greater impact of collective memory with respect to individual experiences, defined by ζ, and a stronger likelihood of being matched in each period, defined by τ, negatively affects the likelihood of an egalitarian social contract, while basing an action on a longer historical memory entails a positive effect. Similarly, if individuals do not only adopt past experiences from others, but in doing so also *inherit* their past *wealth*, the egalitarian contract is more likely to evolve. Inheriting another's wealth may be interpreted as obtaining social rights and status by following one's peers, or as benefiting from legislation or economic ties favouring a group. A longer memory implies a longer reverberation of the initial randomly generated memory, while inheritance leads to an equalisation of socio-economic power. Both effects encourage members to choose strategy M, while a stronger impact of collective memory defined by better performing members and a stronger selection pressure between members have the inverse effect. Thus, local and random replication have also an adverse effect since they increase selection pressure between members compared to variant 4, in which low performing members are imitated with positive probability.

Dynamics differ, if replication follows variant 1. If simulations are initialised with a 50 per cent share of coercive members for both sects, the egalitarian contract occurs with a probability of 36 per cent and a sectarian contract with a probability of 43 per cent (while the absolute cost and the cost difference between both sects have no significant effect). Setting the initial share to 1 per cent and 99 per cent respectively, sectarian and egalitarian contracts occur with the same likelihood as under the other variants of replication. The second model in table 1 illustrates the simulation results. The dummy variable *Balanced* indicates whether the initial distribution was initiated with half of each sect being defined by coercive members. This case renders the egalitarian contract more likely. Similarly, a stronger influence of collective memory and more frequent matching benefit the egalitarian outcome, while inheriting another player's socio-economic power is detrimental. This is in contrast with the other replication variants. If members are likely to imitate singular dominant members, an increased selection pressure and

[14] The latter result is different from the one obtained in the closed-form solution, which assumes homogeneous members. Remember that in the simulations, members are heterogeneous with respect to past history of play. Differences in the cost structure between both sects cause some members to temporarily settle on a sectarian contract, while the majority settles on an egalitarian contract. Therefore choosing M remains the best response and the entire population eventually settles on the egalitarian contract. Since the rate of idiosyncratic play is defined at 0.1 per cent in the simulations, it occurs too rarely to destabilise the equilibrium.

[15] Note that if the sectarian contract defines the dependent variable instead, the signs for each parameter are inverted while the absolute values are approximately identical. This holds both for model 1 and 2.

Table 1: SIMULATION RESULTS

Model	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Egalitarian Contract	Egalitarian Contract	Share of Coercive Attempts	Cross-sect. Conflict	Intern. Unequal Cross-sect. Confl.
Regression	Probit	Probit	OLS	Probit	Probit
Constant			-.2347***		
			(.00834)		
Balanced		.4828***			
		(.01120)			
Collective Memory ζ	-.6395***	.6636***	.4218***	.1996***	.0677***
	(.01250)	(.02459)	(.00613)	(.00976)	(.00708)
Share of Matches τ	-.2792***	.2219***	.3750***	.2163***	.1048***
	(.01152)	(.01548)	(.00625)	(.00962)	(.00714)
Memory Length m	.0134***	.0148***	.0085***	-.0070***	-.0074***
	(.00027)	(.00036)	(.00014)	(.00021)	(.00016)
Inherit	.0565***	-.2034***	.0013	.1725***	.0752***
	(.00813)	(.01024)	(.00435)	(.00663)	(.00505)
Replication:					
Variant 1			.1808***	.4864***	.2950***
			(.01158)	(.01056)	(.01056)
Variant 2	-.1466***		.1891***	.0297**	.0376***
	(.00877)		(.00574)	(.00997)	(.00829)
Variant 3	-.1549***		.1996***	.0284**	.0398***
	(.00878)		(.00572)	(.00992)	(.00827)
N	14,400	11,200	16,000	19,200	19,200
Pseudo R^2	0.3177	0.2396	0.4769	0.2361	0.2105

NOTE.– Coefficients of Probit Regression Show Marginal Effect,s robust standard errors in parentheses. Balanced, Inherit and Type of Replication indicate discrete change of dummy variable from 0 to 1, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Reference group for the type of replication dummies is defined by variant 4. Inherit is a dummy variable defining whether also acquire past pay-off during social learning.

stronger reliance on collective memory increases the probability of an egalitarian social contract, while the same factors benefit a sectarian contract if individuals learn from a larger peer group.

4.2 Identity, Conflict, and Spill-overs

Sectarian identities are subject to changing institutional conditions and discursive practices (Hashemi and Postel, 2017) and are thus constructed by a mixed socio-economic, political and religious heritage. These endogenously evolving sectarian identities are implicitly incorporated in the structure of interaction. The historical memory of past interactions, on which individuals base their choices, defines the role and status which these individuals attribute to members of a specific sect, i.e. the latter's social identity. At the same time, an individual's offer and thus, the self-concept of one's position in the prevalent social contract, i.e. the personal identity is defined in relation to this understanding. Both the sectarian contract and the egalitarian contract are each defined as a pure strategy equilibrium in which mis-coordination is entirely absent. Consequently in each of the three states, each individual's personal identity coincides with the position assigned by others to her sect, i.e. her social identity, and the contracts are socially efficient. Therefore the model provides an explanation for the evolution of sectarian social contracts that assign socio-economic power to a religious marker, but, at this stage, still fails to explain social conflict beyond being a rare random event under variant 2 to 4 imitation.

Yet, sectarian conflict occurs when discursive practices are not strictly following an undirected evolutionary process but are channelled by elites and clientelist politics to prevent alternative non-sectarian social contracts. Elites accentuate differences to shape the distribution of rights and economic privileges in their favour. This is reflected if, at the initial stage, individuals do not base their choices on history of randomly drawn strategies from the entire strategy set (L,M,H), as in the previous simulations, but an a history that is only defined by a randomly collection taken from the truncated strategy set (L,H). In this case, exogenous politics stressed extreme positions and have completely eliminated the memory of an egalitarian offer M. In this case, the population is not only unable to coordinate on an egalitarian contract, but fails to converge to a sectarian contract in 80 per cent of all runs for variants 2 to 4, and in 51 per cent for variant 1 replication. Model 3 in table 1 illustrates the impact of the independent variables on the frequency at which coercive members try to enforce an exchange after a coordination failure. Increased selection pressure (both in regards to frequency and replication variant) and a reliance on collective memory increases the share of coercive attempts and thus, dead-weight loss and sectarian conflict.

In addition, intra-sectarian inequalities based on exploitative social contracts are not confined to sectarian boundaries, but can spill over and cause conflict at the larger cross-sectarian level, while taking on a sectarian veneer. To test the model's predictions, I split each sect into two subgroups. Individuals from different sub-groups but the same sect are able to identify the other's affiliation to a subgroup, whereas individuals matched with a member of the other sect cannot discriminate beyond sectarian affiliation. At the initial stage, all individuals derive their memory from a completely random history of past interaction drawn randomly from the entire strategy set, equivalent to model 1, while only one sect is defined by a subgroup that is 99 per cent coercive, while its other subgroup is entirely acquiescent. The other sect consists of an equal share of coercive and acquiescent members for both subgroups. Thus while at the aggregate, both

groups seem identical (having the same total number of coercive and acquiescent members), at the meso-level, one sect is defined by heterogeneous sub-groups and the other by homogeneous sub-groups. In this case, an internal exploitative norm manifests itself in one third of all simulations, an internally egalitarian contract in 52 per cent. No significant difference exists between the 4 sub-group and 2 sects. It therefore is of no importance where the inequality originated, and the exploitative internal contract can spill over to the other sect. At the aggregate level, the sectarian contract occurs only if individual replicate under variant 1, but conflict between sects evolves in 21 per cent of the cases under any replication variant. Model 4 in table 1 shows which variable contribute to a cross-sectarian conflict. All variable, except for memory length positively contribute to a sectarian conflict, while variant 1 is the strongest driver. In approximately one fifth of all runs, the population converges to a state in which at least one sect is defined by an internal in-egalitarian contract and a sectarian conflict between both sects. Model 5 shows the simulation results for this state as the independent variable. The significant parameters act identical to model 4 with variant 1 replication being the strongest driver.

5 Interpretation and Conclusion

In contrast to the instrumentalist and primordial perspective, the model shows that sectarian identities are not perpetual, but are constructed by an endogenous process of past interactions. Sectarianism therefore constitutes an evolving property in which sectarian affiliation is not the cause of *sectarianisation*, but rather serves as a marker or descriptive characteristic that assigns a role to each sect member in a larger social contract. While the instrumentalist argument stresses that economic competition and political opportunities are the principal incentives of political leaders to externally mobilise identities, the model goes beyond this explanation. These components also constitute elements essential to the endogenous evolution of sectarianism. The model demonstrates a co-evolution of political and economic powers, and sectarian institutions; a fact which is observable in countries like Bahrain, Syria, and Lebanon. Consequently, sectarianism is not motivated by differences in religious ideologies and doctrines, but by political and economic grievances. The model thereby provides an intuition for the self-reinforcing nature of sectarianism. As Hashemi and Postel (2017, pg. 21) write: "Despite the constructed character, sectarianization has the ominous potential to become a self-fulfilling prophecy. Putting the sectarian genie back in the bottle is unlikely to be easy." Yet, contrary to the primordial perspective, a natural social evolution of two groups sharing equal characteristics is unlikely to generate such identities. The model identifies two principal cases in which sectarian contracts can develop: if (1) an antecedent imbalance in the nature of coerciveness exists, or if (2) sect members strongly identify with the pre-eminent member.

In the first case, the model illustrates that ease and frequency of coercion, as well as accumulated wealth and political powers foster the evolution of a sectarian state. For example, the *Kalashnikov culture* and trade in contraband and narcotics have significantly contributed to sectarianism and sectarian violence in Pakistan and Afghanistan (Nasr, 2017). Similarly, the tremendous number of militias operating in Lebanon, Syria and Iraq are other examples of the co-evolution of the increasingly coercive nature of individual interactions and a sectarian social contract. While in this case, the imposition by successful peers of rights and benefits univer-

sal for all sect members fosters egalitarian social contracts, a sectarian society is more likely to evolve if individuals rely more on a collectively shared memory than their own past experience, and are more inclined to adopt rituals and forms of engagements from supposedly more successful peers. This explains the incentives behind state actors and elites with an interest in an increased sectarianisation to invoke the history and norms shared by sect members while retaining elite privileges.

In the second case, however, adopting actions performed by the pre-eminent members, as well as endorsing their past memories support the evolution of an egalitarian and non-sectarian society, while the transfer of power from these members to their followers benefits a sectarian contract. This might explain the *'Do as I say, not as I do'* mentality of elites, such as the Saudi regime acting as a protector of the Shia minority (Al-Rasheed, 2017), or the collaboration of Al Khalifa family with Shia elites in Bahrain (Matthiesen, 2017), and the assignment of rights and positions by sect leaders, as is frequently found in countries like Lebanon.

The model further demonstrates that sectarian conflict is not a naturally evolving property following a non-biased evolutionary process. The literature argues that a fragile state, class dynamics, and geopolitical rivalries form the principal impetus of sectarian conflict (Hashemi and Postel, 2017). Correspondingly, the model demonstrates that socio-economic deprivations and inequalities, as well as power asymmetries between sub-sect actors can spill-over to other groups while taking on a sectarian appearance and leading to a state-wide sectarian conflict. This explains the transformation of non-sectarian uprisings, which initially represented a cross-section of society, into conflicts along seemingly sectarian boundaries, like in Syria, Yemen, and Bahrain in 2011. Similarly, the model also shows that the contestation of existing power relation and externally reinforced rivalries over sociopolitical dominance can lead to a disintegration of a social contract and thus, to a sustained sectarian conflict. Exogenous mobilisation based on economic, social or political differences along sectarian identities can lead to persistent rivalries between sects and a struggle over their position in a social contract (see for example the recent politics employed by the Saudi regime in Al-Rasheed, 2017). This also shows why attempts to devitalise critical movements and to deflect state criticism by strengthening other religio-political groups, as has been done by Sadat and Zia ul-Haq in the 1970s, has let to an increase in sectarian violence. What then appears to be a narcissism of small differences is a conflict not motivated by minor ideological disparities, but by a divergent perception of the role and rights assigned to the sectarian marker.

Since sect only serves as a marker that is endogenously associated to an identity and role in society, it is by itself devoid of religious and ideological content. Consequently, the marker can take on the form of ethnicity or gender, and the model can be directly extended to these contexts.

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