CONVERSION, EXCLUSIVITY, AND STRICTNESS:

A MODEL OF EXTREMISM IN UNIVERSAL RELIGIONS

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Abstract. This paper begins with a theory of conversion to exclusive faiths grounded in rational choice. It argues that exclusivity is a signal that consumers can trust, since it entails an opportunity cost of lost sales to those risk-averse consumers who are turned away by the prohibition to diversify their portfolio of ideological assets. The signal functions like a bond that makes it in the firm's interest to provide high quality. However, the signaling value of exclusivity falls as the sect grows into a universal religion. We model this transition and show that the religion will tend to rely on doctrinal strictness which, unlike exclusivity and other behavioral prohibitions, is not subject to diminishing returns to size. This provides an explanation for several observed forms of religious extremism, from the Islamic to the Roman Catholic variety.

1. Introduction.

This paper is about the intricate relationship of exclusivity, strictness, and extremism in religious sects and universal religions. It tries to accomplish two tasks: first, to offer an explanation of conversion that is firmly grounded in rational choice; second, to explain why, and in what sense, aggressive extremism is observed only within some, not all, religious traditions, and even there only at times of perceived failure, adversity, or decline. Notorious examples include today's Islamic fundamentalism, the Jewish Zealots of the first century AD, and the Anabaptists (*Wiedertaufer*) during the German Reformation. While these two tasks may seem disjoint, it will be the argument of this paper that they are not. In a nutshell, our argument will run as follows. Conversion implies exclusivity; only some religious sects are prepared to demand exclusivity and these grow because exclusivity is productive; its productivity, however, is subject to diminishing returns to size, so that when the sect becomes dominant it turns toward an alternative type of strictness; and when the sect becomes a universal religion, this nondecreasing-returns-to-size type of strictness is used as a tool to indirectly regulate membership and commitment - one of its manifestations being the Islamic extremism that captures the headlines today, another the chronic doctrinal conservatism of the Roman Catholic church.

The last remark may strike the reader as outlandish, but if we look back on history, by far the greatest amount of religion-related carnage and suffering was produced not by terrorist attacks against non-Muslims or apostate Muslims but by persecution and suppression of heresies within Christianity. It is a delusion to think that religious violence is only against outsiders: insiders may well be the chief victims. One thread of our argument will be that doctrinal strictness has been the Catholics' functional equivalent of *jihad*.

Any discussion of religious strictness and extremism in economics must start from the seminal model of «sacrifice and stigma» (henceforth, SS) due to Iannaccone (1992, 1994, 1995, 1997; also Berman, 2000). As is well known, this model views religious sects as clubs whose members draw benefits from collective «production» and therefore value participation and commitment. As all collective groups, religious clubs are plagued by free riding. To reduce free riding, sects impose costly sacrifices on members in the form of restrictions or prohibitions on behavior (diet, drink, dress, sex, social intercourse, deviant beliefs). The economic rationale for this is that of an efficient tax on externalities: instead of subsidizing participation, which is not easily observable, sects resort to taxation of secular consumption, reducing the value of outside activities. As a result, less people join but those who do supply

more intense participation to everyone's benefit; hence the sacrifice is efficient, not irrational. That explains why today strict churches are strong and grow.

The SS model makes an important contribution towards understanding even the most unlikely and extreme manifestations of religious behavior as rational from the group's point of view. As Iannaccone rightly emphasizes, most sectarians are perhaps radical but benign and peaceful, while only some are destructive and aggressive, but the model itself is silent about which sects may turn aggressive and when. This silence is due to the two main limitations of the model. First, it does not clearly distinguish between prohibition/regulation of *secular* consumption and regulation of *religious* consumption; that is, it does not address a type of strictness based on theology and practice within the religion, as opposed to interaction with outsiders, that is characteristic of *some* religions. Doctrinal strictness is not simply another tool to be added to the toolbox of sacrifices at a sect's disposal: for most of those tools are, whereas doctrine is not, subject to decreasing returns to size. This brings us to the second limitation of the SS model: it has so far not taken a total-economy standpoint for analysis. It seems designed for sects and well suited to the study of inter-denominational competition in a pluralistic religious market, such as the American one, but it has so far failed to address the genetic mutation that a sect undergoes when it becomes the dominant religion in a society and therefore must commit itself to universal admission. A universal religion is not just a sect writ large: it is bound by a rule of free access, and this should deeply affect the mix of prohibitions or sacrifices that the religion chooses.

We will address these questions by means of a sequence of models that preserve, but also extend, the insights of the SS model. Before that, it will be necessary to set the stage by sketching out a theory of conversion and a classification of religions in terms of types of strictness. This will be the subject of sections 2 and 3 respectively. Section 4 develops the models, while section 5 tries to engage the historical evidence. Section 6 concludes.

2. A theory of exclusivity and conversion

2.1. The problem

In ordinary usage, the word «conversion» carries the connotation of an abrupt shift of behavior, whereby people are supposed to give up their old ways in one bound and thoroughly embrace an entirely new package of belief and behavior. The prototype example that may lie in the back of most Westerners' mind is Saint Paul's, who was thunderstruck on the road to

Damascus. As soon as one has once seen the light, one is no longer allowed to indulge the old beliefs and practices. Conversion implies that there is no halfway house between the old and the new: one is expected to take a plunge into the new faith - to «believe» it, literally. So conversion is first of all a matter of intentions, not conduct nor conviction. It is never an intellectual process of rational argument over competing doctrines and final choice of the best doctrine. The sympathizer may well read a book or attend a lecture about Jesus Christ, but the decision is eventually made by the heart. Leaders of religious organizations have always known that while the heart may be perfect, the brain and the body are not, so the initial plunge must be followed up and strengthened by intense socialization in the new faith's tenets and gradual learning of the new practice. Ideally this will subsequently convince the neophyte that his/her initial leap was well taken, but the leap itself is made prior to the conviction. It is this first step that poses a problem for addicts to the rational choice approach. This section is an addict's attempt to provide a solution to this problem.

If one has to jump, it is because there is a yawning gap in the path. The gap is created by exclusivity: certain faiths demand and enforce exclusive dealing by destroying the intermediate opportunities of multiple membership. With those faiths, one cannot have it both ways: it has to be either in or out. So in its proper, strong sense, conversion occurs only to, or from, exclusive faiths, and reciprocally, exclusivity implies that joining can occur only in the form of conversion; a simple change of mind does not qualify as conversion. Two questions then immediately arise: why do some faiths demand exclusivity and conversion, which is obviously costly to the prospective member? And why do some people - sometimes, very many people - take the exclusive deal and convert? The first question has been addressed by Iannaccone (1995), whose answer is that exclusivity, like other prohibitions and sacrifices, helps to deter free riding and raise participation and commitment among the membership. The second question has not, to my knowledge, been addressed by economists so far. Yet it is an important question: if exclusivity were always an inferior offer, exclusive organizations would not be viable; if, at the opposite extreme, exclusivity were always a superior offer, all the observed, viable organizations would demand it. Neither, however, is the case. Thus the consumers' reaction to exclusivity affects the form and outcome of the competition among rival faiths. This section offers a joint answer to both the questions above: exclusivity is a signal that the product is of superior quality; that is why some suppliers request it and some consumers are willing to accept it.

2.2. Exclusive faiths: some illustrations

Perhaps the benchmark setting for the problem of religious conversion is the Mediterranean world from about the 3rd century BCE to the 4th century CE, where it first presented itself in known history[1]. The polytheistic religion of the classical world was a composite array of cults, in which supplicants made sacrifices and offers to different gods to propitiate good fortune in a strictly *quid-pro-quo* exchange relationship (Ferrero, 2004). The priesthood was a disparate collection of temple caretakers, who lived off the offers but were not supposed to be exemplars of moral behavior. Indeed, ethics was no part of ancient religion: the latter was just not intended to regulate personal conduct; the gods were powerful but not necessarily «good». And the believers were not a community: religious practice did not involve living together or sharing experiences with fellow believers. It was a strictly individual activity. Consequently, the notion that to embrace one cult one should forswear allegiance to all other cults was entirely foreign to the ancient frame of mind: conversion had no meaning in this world (Nock, 1933). In the course of time, new cults kept coming in from the East, and were lined up alongside the others for the supplicants to choose from. The system was one of unlimited tolerance of diversity, one which could in principle accommodate every newcomer - including two of the exotic Oriental religions: first Judaism and later Christianity.

The Jews and the Christians, however, rejected such an accommodation. They were unique in the ancient world in that they demanded exclusivity and offered membership in a community in return. The spectacular rise of Christianity from deviant Jewish sect to world religion has exercised generations of historians, biblical scholars, and sociologists of religion. There seems to be a broad agreement that the key factor in the Christian success was that the promise of man's salvation for the last times was backed and made credible by the tangible benefits of participation in a community that provided collective goods to its members. In this the Christians followed the earlier Jewish example, the key difference being that Judaism was always tied to ethnicity and imposed costly rites of admission, whereas Christianity from the beginning broke free of it (Stark, 1996).

If we put the ancient Roman case in comparative perspective, we see that conversion arises as an issue only on certain conditions. First, conversion implies faith, and not every

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[1] The first-ever monotheism seems to have been founded by the prophet Zarathustra towards the end of the second millennium BCE, displacing the original Indo-European polytheism. In time, Zoroastrianism became the state religion of the Persian empire, but exclusivity seems not to have been enforced -–witness the freeing of the Jews from Babylonian captivity. Too little is known of this precedent, however, to make any firm statement. See the fascinating account of Kriwaczek (2000).

religion is based on faith; some are based on ritual and propitiation of overarching powers. Secondly, the faith must be exclusive; thirdly, this faith must aim at propagation; and fourthly, this propagation must take place in a competitive environment. Ancient paganism is the prototype of a nonexclusive religion, one not based on faith. Judaism has been an unswervingly exclusive faith from the beginning, but while in Hellenistic and early Roman times it was actively and successfully proselytizing across the Mediterranean, roughly after the defeat of the second Jewish war it turned inward and gave up seeking conversions to this day. As another example of an exclusive faith, Islam under the early Caliphate did not actively seek, let alone force, conversion of subject peoples. Yet another example is a number of Protestant sects issued from the Reformation, such as Amish and Mennonites, which seem content of reproducing themselves without expansion. As to competition, the early Christian situation has been unique in the history of Catholic Christianity. In the Roman empire, the new religion came up against an established religion that had been in place for centuries, amidst the mistrust, and often the hostility, of the surrounding society, and it had to face up to the challenge of many other new cults that also were blooming in the cracks of the traditional system. Fighting its way up from the bottom of society proved so hard that, in the later waves of expansion outside the empire, the church took the easier path from the top down whenever feasible: the Christianization of the Slavic, Germanic, and Scandinavian lands, as well as of Spanish and Portuguese America centuries later, was carried out by converting the ruler first, or by enlisting the strong arm of a Christian colonial power. Only in modern times, when the attempt to gain the favor of the states of South and East Asia disastrously failed, was the Catholic church confronted once again with the challenge of competition - and in the event, its performance proved modest.

An important point here is that, perhaps counterintuitively, monotheism is *not* necessarily exclusive nor does it necessarily demand conversion. The monotheistic *theology* is of course, by definition, exclusive, but the corresponding *organization* need not be. For example, a number of new cults that contested the ground to the early Christians - such as Mithraism and Manicheism - were variants of the Zoroastrian religion of Iran and were actively proselytizing but did not insist on exclusivity. As another example, the very many Protestant denominations are not exclusive towards one another or towards other Christian brands: if one moves from one denomination to another this is not perceived by either party as «conversion», only a change in emphasis or practice, since there is thought to be no authority on revealed truth beyond Scripture itself. So «reborn» Christians are not converts but revived, or re-activated, previously slumbering believers. By contrast, the Catholics still today view anybody joining from anywhere, including from other Christian denominations, as converts,

since it is a progress from error to truth. It follows that a rational theory of monotheism (see the impressive effort by Stark, 2001) is not, or not quite, a theory of exclusivity or of conversion.

2.3. Exclusivity as market signaling

A good starting point is Iannaccone's (1995) useful classification of religions in terms of their response to risk. The quality uncertainty surrounding religious products is enormous, as claims cannot be conclusively evaluated ex ante and there is no effective mechanism for lodging complaints and seeking redress ex post. Religions have evolved two types of response to this extreme degree of uncertainty. One is collective production: there is a congregational structure that emphasizes participation and commitment by ordinary members and keeps down both numbers and salaries of professional clergy. To control the free rider problem associated with collective production, these religious organizations resort to costly demands on members - «sacrifice and stigma» - whose functional purpose is to screen out the less committed members and to raise the opportunity cost of alternative activities for those who remain. These costs typically take the form of prohibitions or limitations of secular activities that would otherwise compete for members' time, effort, and resources. The other organizational response to the ultimate uncertainty inherent in religion is portfolio diversification. In societies in which there is at least a degree of religious choice, rational risk-averse «investors» will minimize risk by holding a diversified portfolio of religious assets. Religions that cater to this sort of demand are made of specialized, fee-for-service producers, who sell their products to individual customers; there are no real «members» to speak of. Since there is no collective activity there is no free riding problem, and therefore no limitation on outside activities. Customers of these firms will thus bear no cost for patronizing many different firms. Brand loyalty is here no higher than with secular producers. In contrast, congregational religions will accommodate the pressure to diversify in-house and take «a department store approach to religion - comprehensive belief systems, cradle to grave services, extensive and varied social networks, and so forth» (Iannaccone, 1995, p. 289).

The problem of exclusivity comes in at this stage of the argument: if the demand for diversification is so great, how can churches resist it under competition? Iannaccone's answer is centered on different production technologies. Some religions produce private goods and lend themselves to diversification. Others rely on collective production as an uncertainty-reducing mechanism and hence have to enforce costly prohibitions of secular activities to reduce free riding. But if these prohibitions have the purpose of binding people to the

religious group and isolating them from alternative activities, such a purpose would be defeated if people were allowed to participate in competing religions. Hence restriction on *secular* consumption necessarily entails restriction on alternative *religious* consumption. Thus exclusivity follows from collectively-oriented religion.

There is no doubt that exclusivity deters people from diversifying and free-riding. Exclusivity is in a sense the ultimate prohibition, as it goes to the heart of what religion is all about - although such an approach makes it difficult to explain why some collective, monotheistic religions are de facto not exclusive, as we have seen. However, this view of exclusivity explains why it may be rational for collective religions to *demand* exclusivity, but not why it is rational for people to *supply* it and convert; hence, it falls short of being a full theory of conversion in the sense defined above. It may well be true that for some people the high costs of exclusivity are more than offset by the benefits of a given communal religion, so self-selection in a large free market will ensure that virtually all exclusive religions draw at least some minimal following and survive. But explaining rapid, spectacular expansion among the adult population seems an altogether different matter. Recalling the early Christian example discussed above, how are we to explain the quantum leap from paganism to an exclusive faith by large numbers of people? Granted that, once in, many people will find that the benefits of membership are indeed worth the costs ex post, how can any sensible, not to say rational, individual bring himself to «burn» all his religious assets and take a plunge into the unknown? In what sense is this rational on an ex-ante basis? There is a problem of moral hazard of unparalleled magnitude here: how can a prospective convert have some reason to trust that he's not just being cheated, or sold a lemon?

The theory of market signaling holds the potential to provide an answer. In its basic formulation (Spence, 1974), the informed party that suffers from the other party's inability to observe product quality or productivity differences has an incentive to signal. To be credible, the signal must be costly to the signaling party; and to be successful, the signaling cost must be such that those who stand to gain from the lack of observability have no incentive to undertake it. In the standard illustration, workers of superior ability have an incentive to undertake schooling to signal their productivity to employers. This move succeeds if it yields a separating equilibrium, in which unit costs of education for the two groups and the amount of education are such that the high-productivity group undertakes it whereas the other group does not. In homogeneous groups where adverse selection is not an issue but moral hazard is, the signal becomes an initial sunk cost, much like posting a bond, that can be recouped only through repeated trade in subsequent periods, thereby making the honest strategy profitable, as in models of price premiums on high-quality products (Shapiro, 1983; Klein and Leffler,

1981). In the price premium literature, the sunk cost can be either a conspicuous, non-recoupable expenditure, such as advertising or pure waste, or an initial investment in reputation. In all variants of the signaling mechanism, an important implication of the theory is that the necessary amount of signaling or sunk cost is proportional to the value of the hiding or cheating strategy, respectively: the more the low-productivity worker, the quack, or the low-quality seller stand to gain from undercutting quality or from hiding in the larger group, the larger and more expensive the signal will have to be to implement contractual compliance by, or separation from, them.

Let us now apply the insights of the signaling model to religion. Consider a competitive religious market with no barriers to entry and umpteen non-exclusive, «private» religious firms servicing consumers, as in the Roman empire. Suppose a collective, monotheistic religion enters this market without requiring exclusive membership. The organization offers a communal worship but incurs no cost from doing so. People will visit this group in their spare time, at no cost to them, and find the experience disappointing: communal life will be unrewarding precisely because nobody is putting in much effort or commitment. But these visitors will reason: this is just what we should have expected, for there is nothing to suggest that this new group should be any better than the others. In a large society the new group will nevertheless be viable because it will find some people especially willing to patronize it, but it will remain small.

Suppose instead that the new religion requires exclusivity. It incurs an opportunity cost from doing so: this is the value of the «business» lost because of exclusivity. If the religion's success is measured by the number of members, this cost is proxied by the number of people who would otherwise join but are turned away because they are prevented from diversifying their religious portfolio. If this were all there is to it, the exclusive strategy would put the organization at a competitive disadvantage. But the people will notice that this group is willingly incurring a seemingly gratuitous cost, and they will reason: if this group behaves this way it must be because they are advertising a superior product and expect to recoup the initial cost through future «sales»; if they were selling a lemon, they would just be throwing one-period business away. This expectation of superior quality is self-fulfilling: once they join in, the people find the experience rewarding and worth continuing, not because they gain access to the proof of the religion's ultimate truth - this they never will - but because they find a fulfilling collective life catering to their various needs and supported by high participatory effort. Thus the exclusive strategy pays back because prospective members think they have reason to trust a group which is posting a bond in advance of «sales»: the higher the value of the bond, the higher the trust. In turn, given the technology to enforce exclusivity, the

opportunity cost of the exclusive strategy - the value of the bond - is the higher, the more diversified the portfolio of non-exclusive religious assets can be. Hence, in principle, a testable implication of this model is that, given that an exclusive religion is on offer, we should observe a positive correlation between a religious market's product assortment mix and the rate of conversion. Anyway, the signaling value of exclusivity as a sunk cost seems to be the key to the occurrence of conversions[2].

Emphasizing the supply side of exclusivity, in addition to the demand side stressed by Iannaccone (1995), does more than simply yielding a richer description of the mechanism of conversion. If participation in competing religions is a liability that detracts from a person's commitment to a particular group, and if this is the reason for prohibiting it, then the achievement of monopoly and the withering away of the competition can only be good for the group: there's virtually nothing left to prohibit. But if the group turns this liability into an asset that signals high quality and attracts the most committed people, as we are suggesting, then the value of this asset to the group cannot be independent from the existence and strength of the competition. When the religion has expanded so much that it includes most of the relevant population and the competition is in disarray, the effectiveness of exclusivity as an incentive mechanism is destroyed because the possibility of portfolio diversification is now minimal. In this sense, exclusivity is only one - perhaps the most important one - of the behavioral prohibitions considered by the SS model: these too crucially depend on interaction with outsiders and so their effectiveness falls as the religion's membership increases. It follows that a religion in these straits will be likely to look for substitute incentive devices that are not subject to decreasing returns to size. To this is devoted the next section[3].

3. Universal religions and types of strictness

A commitment to proselytize and convert, at least in theory, the whole world amounts

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[2] One might wonder, if exclusivity is such a good business strategy, why do competitors not follow suit and request it too? Simply because some religious firms are not equipped to provide the collective goods that only make the high expectations towards the exclusive group self-fulfilling, so that the exclusive strategy would be disastrous for them.

[3] A caveat is in order. The signalling theory set forth above lays claim to being a theory of the competition between a collective group and many private suppliers. All it does is to show that under some conditions, exclusivity is a superior strategy for a collective faith. It cannot, however, extend to the competition between two or more collective, exclusive groups, such as Jews and Christians in the Roman empire, or Christians and Muslims in the medieval Middle East. Addressing this more complex problem requires additional tools of analysis.

to subjecting the religion to a free-access constraint. That is, once a universal, missionary religion is established, its door must be open to anybody who wants to come in - even leaving aside exceptional cases of forced conversions. Assuming that the religious organization aims at maximizing net per capita benefits of its members (see below), there will be an «optimal size» of the organization, i.e. a number of members at which per capita benefits reach a maximum; this optimal size will of course depend on the resources and leadership available to the organization at any given time. But the rule of free access deprives the organization of the option of keeping surplus members out and forces upon it a level of membership that will typically tend to be excessive from the point of view of benefit maximization. In these conditions, however, there is another tool that the religion can use to indirectly regulate its level of membership: the degree of «strictness», i.e. the nature of the doctrinal and/or behavioral demands imposed on members and especially on prospective candidates for leadership positions.

Generally speaking, a radicalization of doctrinal positions or behavioral requirements has two effects. First, it invariably makes activity and careers within the religion harder, riskier, or more costly, and therefore turns away potential candidates; higher benefits would be required to compensate for the higher personal costs of stricter religion. This, I submit, is precisely the intended purpose of a regulation of the degree of strictness: it takes the place of the direct rationing of admissions, which becomes unfeasible in a universal religion with free access, and helps to solve the excess numbers problem created by free access by «voluntarily» driving members out. Secondly, however, strictness has an ambiguous effect on benefits: depending on the specifics of each case, up to some point increased strictness may increase the organization's popularity and resources and its members' commitment and productivity; sooner or later, however, a point is reached beyond which further radicalization becomes counterproductive. By balancing out these contrasting effects, each organization gropes for an «optimal» degree of strictness, i.e. one which, through its combined effects on members' willingness to join and their productivity, achieves the number of members which produces maximum benefits for the average member given the free access constraint. Predictably, when environmental conditions change, the religion will be driven to change its degree of strictness in pursuit of maximum per capita benefits. We will have to ask which environmental changes may drive the religion to turn more radical.

Before examining strictness more closely, let us pause and clarify a few points. First, neither the problem of free access nor its solution (regulation of strictness) are unique to universal religions. They are also typical of secular political organizations, especially revolutionary parties, whose stated purpose is to mobilize broad masses of people of certain

classes, and which therefore are in a sense constrained to take in all applicants who qualify. Classic examples from the 20th century are Communism and Nazism. As I discussed at length in previous work (Ferrero, 2002a), these revolutionary organizations dramatically changed their programs and policies at critical junctures, using the degree of extremism (or strictness) as a device to indirectly control membership levels and hence per capita benefits of members. Mass-based revolutionary parties typically display what I called the paradox of the radicalization of successful revolutions: many famous instances of historical revolutions turned more radical just when they achieved victory and state power was firmly in their hands. By contrast, universal religions appear to be in the grips of the opposite syndrome: they tend to show an extremist reaction to failure, adverse conditions, or increased competition, as we will see below. To anticipate our argument, this basic difference in the reaction to environmental changes can be explained by the average member's different attitude towards extreme doctrines and practices. To the secular political activist, turning more extreme implies treading on new, unknown ground, fraught with uncertainties; so the activist will rightly demand adequate compensation for it, which can be paid out only when the prospects of success, and hence its expected dividend, improve. To the religious activist, by contrast, turning more extreme «only» implies going back to precedent and certainty, blessed by some sacred authorities; and this is a resource that can be put to use in hard times. In short, secular revolutionaries can be expected to be more averse to extremism than religious activists (or political activists inspired by religious beliefs).

Secondly, «universal religions» is a loose term that requires qualification. What I have in mind is a religion bound by the self-imposed constraint of free access, which in turn implies (1) a religion addressed to everybody, at least in principle, (2) a religion based on collective practice or worship, in which numbers are relevant, and (3) a religion founded on exclusive belief in a personal God who entertains an active «exchange relationship» with man through a covenant or a promise of salvation (Stark, 2001). The first requirement excludes sects based on esoteric knowledge, in which initiation functions as a screening mechanism to regulate admissions. The second requirements rules out religions based on individual offers and sacrifices privately provided at different temples, in which the numbers problem is not an issue, such as Hinduism and ancient Greco-Roman paganism. The third requirement rules out religions based on essences, such as Taoism, or devoted to the pursuit of personal salvation through meditation and renunciation by a self-selected class of religious professionals (monks), such as Buddhism; here self-selection functions as regulator of membership. Only if these three requirements are satisfied can a membership problem meaningfully arise.

This leaves us with the three great monotheistic traditions, which is where nearly all

known cases of militant fundamentalism are found. But even monotheism needs qualification: even though, theologically, it of course implies the imperative that all the world ought to surrender to the one and only God, i.e. it is universalistic, organizationally this need not be, and indeed in history has not been, always the case. Judaism was an actively proselytizing religion in the ancient Mediterranean world, but after the disastrous failure of the last Jewish revolt against Rome (AD 135) it gradually withdrew from missionizing and became an exclusively ethnic religion. Christianity began as an exclusive sect which carefully controlled admissions and became a universal religion only after Constantine's edict of toleration (AD 313). After the Reformation, several Protestant sects have been virtually closed to new members. As to Islam, in its first two or three centuries if functioned as the religion of the Arab conquerors and did not seek nor encourage conversion of the Jews and Christians of the Near East. Only in the tenth century AD did the pace of conversion to Islam gain momentum; concomitantly, the caliphate lost its religious authority and the ulama class emerged as the custodian of doctrinal interpretation (Berkey, 2003). Thus, it is only in the open-door, proselytizing instances of monotheism that the free access problem arises and the need to regulate access through the control of strictness becomes significant.

Strictness comes in two different forms: behavioral and doctrinal. The behavioral variety focuses on the believer's behavior in the secular world and sets constraints or restrictions on permissible conduct, in matters such as food, drink, dress, physical stigmas, intercourse and intermarriage with outsiders, celebration of religious festivities, permission to work at particular times, prescription of prayers and other forms of worship. These are the demands that the SS model focuses on. They are publicly observable behavioral traits that mark out membership in a religion vis-à-vis outsiders. By contrast, doctrinal strictness focuses on belief and, since belief is unobservable, emphasizes practices within the community of believers and under the organization's supervision, such as submission to sacraments, participation in the mass, confession and penance. Both forms of strictness come by degrees, so that it makes sense to speak of «more» or «less» strict relative to alternative or previous instances.

For reasons that lie beyond the scope of this paper, particular religions tend to specialize in one or the other of the two forms of strictness. Mainstream Christianity, at least since the Constantinian age, has had very little in the way of behavioral demands and prohibitions: excesses in all fields are of course branded as sinful, and times for worship are marked out on the calendar, but otherwise there are no generally applicable, special restrictions of behavior vis-à-vis outsiders (there are indeed severe restrictions but on a «voluntary» basis, for those who choose to join religious orders). Instead, since the council of

Nicaea in AD 325, Christians of different persuasions have been classified into orthodox and heretics and requested to conform to the demands of a religious practice which has been specified in detail and founded on sophisticated, not to say abstruse, theological arguments, culminating in the principle that there is no salvation outside the church (*extra ecclesiam nulla salus*). Conflict and controversy within both the Western and Eastern churches have always been, at least ostensibly, over issues of theology, even though these had obvious implications for religious practice. The Protestant Reformation of course also started as a theological heresy, but it then set a new course into motion: Martin Luther's principle that there is no other source of religious authority beyond scripture (*sola scriptura*) destroyed the church's monopoly of salvation, downsized or, in the more radical denominations, completely abolished the role of sacraments, and eventually led to reversion to the early Christian form of congregational association distinguished by outward behavior. From then on, doctrinal differences among Protestants would take the form of the formation of new sects. In Protestantism, religious extremism took once again the form of stricter behavioral rules - a striking parallel to Judaism and Islam, to which we now turn.

For all their differences, Judaism (since at least the Talmudic age) and Islam have one key feature in common: behavior, not theology, defines membership in the religion. In both, discussion on the nature of God, creation of the world, and other such theological matters is left to the speculation of learned scholars but not required of the ordinary believer. There are no sacraments, only communal rituals. The rite of entry (conversion) to Islam involves the simple acknowledgment of the one and only God, that Muhammad is His prophet and the Koran is revealed scripture; beyond that, everything revolves around public behavior. In short, there is no «church» of Judaism nor of Islam: as (individual or collective) salvation hinges exclusively on obedience to the prescriptions of the Law, as scripture is the only source of the Law itself, and as scripture needs interpretation if it is to guide everyday conduct, the need arises for a class of specialists (the rabbis and ulamas respectively), akin to legal scholars, who give advice on proper application of the Law. As has often been remarked, however, there is nothing beyond the followers' consensus to give one scholar or one school of interpretation more authority than another. In this particular sense, Judaism and Islam, as well as Protestant Christianity, are inherently competitive religions.

If this framework is accepted, then we have the beginning of an answer to the question raised in the introduction: why militant radicalization has historically occurred only within some, not all, religious traditions. If we recognize the distinction between strictness of behavior and strictness of doctrine as alternative tools of membership control under free access, then it follows that when, for whatever reason, a religion wants to turn more extreme

and squeeze out its less committed members, it will resort to doctrinal radicalization if it relies on regulation of religious belief and practice, like Orthodox Christianity and Roman Catholicism, whereas it will resort to behavioral radicalization if it relies on regulation of secular behavior, like Judaism, Islam, and Protestantism. Therefore, the first type of religion restricts admissible belief more severely and enhances its struggle against heresies, whereas the second type hardens behavioral norms and requirements and calls for stricter enforcement of the Law. Thus the first type of religion turns upon its own members, while only in the second type is there the potential for aggressive radicalism against outsiders. In turn, this potential will be realized only if and when, in the eyes of the militants themselves, there is good reason for the religious action to target the general society and become «political». Islam is a particularly promising candidate here because religion, politics, and civil society are inextricably intertwined in the conception of the *umma*, the rightful Muslim community, and the *shari'a* is supposed to apply to everybody in a Muslim society. As to the other religious traditions, one instance in which the religion becomes political is revolutionary millenarianism, which we will discuss below. For now, let us note that in economic terms, behavioral regulation can be rationalized as restriction or taxation of *secular* consumption, while doctrinal regulation as restriction or taxation of alternative *religious* consumption. Thus our model, while preserving the insights of the SS model, enriches and extends it to capture the «theological» variety of strictness.

Finally, as noted above, the SS model does not explicitly deal with strictness in universal religions. As with exclusivity, discussed in the previous section, one would think that behavioral strictness is subject to diminishing returns to size: the value of a given sacrifice for the organization falls as membership approaches the entire population. For example, drinking is typically a social activity, so a prohibition on drinking reduces the attractiveness of social intercourse with outsiders and enhances the value of activities inside the group. This makes sense in the USA, where the Mormons are a minority and secular activities compete for the members' time and effort. But in a society where everybody is a Muslim except some circumscribed minorities, the usefulness of prohibiting drinking is presumably very low. So we would expect a more lax and lukewarm enforcement of the prohibition. But in principle at least, the Law is still there, because it's in the books and the books are the sole source of truth. This situation offers an window of opportunity for a group to gain ascendancy by advocating a «return» to a truer interpretation of the Law through a hardening of behavioral norms. Thus the potential for extremism is in a sense endemic in such a society. So in a somewhat modified form, the SS model's insight that sects seek to maintain an «optimal distance» between insiders' norms of behavior and the outside world can be confirmed and extended to

a society dominated by one behavior-based religion, such as a Muslim society.

By contrast, doctrinal strictness does not rely on interaction with outsiders and hence is not subject to decreasing returns to size. The model that follows will make it clear that the two types of strictness work in very different ways.

4. Two models of a religious organization

4.1. An exclusive sect: the unconstrained cooperative model

We will model our religious organization as a producer cooperative intent on maximizing net benefits per member; here, unlike in a standard profit-maximizing firm, "labor", or membership, is both a production factor and the ultimate «owner» of the organization's residual. There may be several rationalizations for this assumption, perhaps the most basic being that the benefits of religious production, unlike commercial revenue, accrue in a nonmonetary form and therefore, in the absence of side payments, cannot easily be redistributed to nonworking owners as would be the case in an investor-owned, profit-maximizing firm. Hence it is natural to assume maximization of per capita benefits as the organization's objective, which is of course compatible with an unequal distribution of benefits among members and with a role for hierarchy and leadership. We will retain the cooperative modelling device also in the second model, where the religion is subject to a free-access constraint.

Exclusivity and doctrinal strictness will be treated here as production factors which, together with members' labor, cooperate in the production of benefits. However, there are no separate transactions involving either exclusivity or strictness; these factors are not purchased or rented in markets independently of labor. Rather, they are to be understood as characteristics of the effort required of members, collectively decided upon by the organization in its pursuit of benefit maximization. Their «price» is included in the total rewards, or benefits, paid out by the religion to its members. The latter, on their part, evaluate both the cost of these characteristics to them and their prospective rewards when they decide to join or quit, and to supply effort within, the organization.

Consider a religious cooperative which uses members' effort, M, an exclusivity signal, E, and the degree of doctrinal strictness, D, to produce benefits per member, y. However, if neither exclusivity nor strictness are used, member labor alone can produce positive benefits. Both membership and strictness are subject to diminishing returns as usual.

Furthermore, they have an optimal level from the benefits point of view: beyond that level they turn counterproductive and begin to lower benefits. The optimal level of membership, in particular, is controlled by a scale factor, k: an increase in k expands the organization's size. On the other hand, exclusivity need not be subject to decreasing returns, so we will posit a constant marginal product. The technology of religious production is thus:

$$y = y(kM, E, D) \quad \text{with } \frac{\partial y}{\partial M}, \frac{\partial y}{\partial D} \text{ first} > 0 \text{ then} < 0, \frac{\partial y}{\partial E} > 0, \frac{\partial y}{\partial k} > 0,$$

$$\frac{\partial^2 y}{\partial M^2}, \frac{\partial^2 y}{\partial D^2} < 0, \frac{d^2 y}{dE^2} = \frac{d^2 y}{dEdM} = 0, \ y(kM, 0, 0) > 0, \ y(0, E, D) = 0 \qquad (1)$$

There is, however, a basic difference between E and D as benefits-producing factors: E is, whereas D is not, subject to decreasing returns to size. The value of exclusivity as a signal, i.e. the cost incurred by members through forsaking alternative opportunities, depends on the range and value of such forgone opportunities, hence it decreases as more and more people join the religion and less and less outsiders are left to be excluded. It follows that even if we conceive of exclusivity as a dichotomous, either/or choice, whose productivity is fixed, its contribution to benefits will fall as membership expands. By contrast, the value of doctrinal strictness to the organization does not fall as membership expands because it does not rely on interaction with nonmembers; if anything, strictness becomes more effective as the organization widens its reach and strengthens its control over society. Because of this relationship we would expect that as the religion expands and the value of exclusivity falls, the religion will tend increasingly to resort to doctrinal strictness. This is embodied in the exclusivity function:

$$E = E(M) \qquad \text{with } \frac{dE}{dM} < 0, \frac{d^2 E}{dM^2} \gtrless 0 \qquad (2)$$

Substituting (2) into (1) we get

$$y = y(kM, E(M), D) \qquad \text{with } \frac{\partial^2 y}{\partial D \partial M} \geq 0 \qquad (3)$$

in addition to the previous specifications. The cooperative's problem is to maximize (3) with respect to M and D. Assuming that the coop can find as many members as it wishes to admit, this yields the first-order conditions:

$$k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} = 0 \tag{4}$$

$$\frac{\partial y}{\partial D} = 0 \tag{5}$$

Unsurprisingly, the benefit-maximizing levels of membership, M*, and of strictness, D*, are such that their respective marginal products are equal to zero. The MP of membership includes both the direct effect of members' labor and its indirect effect via E. Note from equation (4) that, at the optimum, $\partial y/\partial M$ >0, implying that M* is lower than the level of membership , say M°, that would be chosen by a twin group which will not, or cannot, enforce exclusivity, and which would therefore set $\partial y/\partial M$ =0.

Furthermore, if the MP of strictness increases with membership, and reciprocally, the MP of members increases with strictness ($\partial^2 y/(\partial D\partial M) = \partial^2 y/(\partial M\partial D)$ >0), it is easy to show that D* < D°, i.e. the optimal degree of strictness is lower in the exclusive religion than in the nonexclusive one[4]. In other words, if strictness and membership are technological complements, an equilibrium with a smaller membership will also feature a lower level of strictness. This technological interdependence is created by the twin facts that strictness and exclusivity are substitute tools to enhance members' productivity and that the productivity of exclusion falls with membership size, so that a larger membership will induce substitution of strictness for exclusivity and viceversa. By contrast, a nonexclusive religion, which does not avail itself of such substitutability, breaks down the technological complementarity and has no reason to restrict either members or strictness. We have thus proved the following proposition:

Proposition 1. An exclusive religion which maximizes per capita benefits unconstrained by member's supply will have a smaller membership and, if the MP of strictness increases with membership ($\partial^2 y/(\partial D\partial M)$ >0), will be less strict than an otherwise identical, nonexclusive one.

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[4] Since at (M*, D*) $\partial y/\partial M$ >0, M must increase to reach the optimal M° for a nonexclusive religion. If $\partial^2 y/(\partial D\partial M)$ >0, this increase raises $\partial y/\partial D$ (which is zero at (M*, D*)) to a positive level, so D too must increase to reach D°. Hence the curve y(D), given M, of a nonexclusive religion is steeper than that of an exclusive one everywhere in the neighborhood of equilibrium, so that the former's curve peaks to the right of, and below, the latter's.

This proposition captures the fundamental insight of the SS model: by imposing an entry cost the religion shrinks in size but enhances commitment to the members' benefit. As discussed above, the first and foremost such sacrifice is exclusivity of religious practice itself: the M* people who join the exclusive religion, from among the M° people who visit the otherwise identical but nonexclusive one, can properly be said to undergo *conversion* - and rationally so because they stand to gain from it. This is a separating equilibrium of a signaling game in that those groups which are not equipped, or find it too costly, to send out the exclusivity signal will not do it; if, contrary to our assumption ($y(kM,0,0)$ >0), no benefits could be produced without exclusivity, the nonsignaling groups would not exist in equilibrium. However, in this model signaling is productive and welfare-enhancing.

The new twist to the SS model that is suggested here is that the effectiveness of exclusion decreases as the organization's size increases. As the scale parameter k becomes larger and the organization's membership grows, per capita benefits fall and consequently, if a larger membership enhances the productivity of doctrinal strictness, the incentive to counteract this through resort to increased strictness - if the religion can avail itself of such an option - increases. Formally, we have:

Proposition 2. An exclusive religion which maximizes per capita benefits unconstrained by members' supply will be driven to increase doctrinal strictness as its membership expands as a fraction of the total population, provided the MP of strictness increases with membership ($\partial^2 y/(\partial D \partial M)$ >0). By contrast, in a nonexclusive religion (E=0) optimal strictness is invariant to scale.

The proof is in the Appendix. The situation is illustrated in Figure 1, which depicts, for a given level of strictness D, the benefit curves for a nonexclusive religion, y(kM), the benefit curves for an exclusive religion, y(kM, E(M)), and the exclusivity curve E(M), all as functions of membership M. The increase in the scale factor, k, shifts both benefits curves to the right, from those labeled y_1 to those labeled y_2. For a given scale, exclusivity curtails membership from M° to M* and correspondingly raises per capita benefits[5]. Growth lowers per capita benefits in the exclusive religion: as size expands the curve y(kM) shifts horizontally to the right but E and hence y(kM, E(M)) fall[6].

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[5] If the y function is separable in M and E, for any given M the height of y(kM, E(M)) is simply the vertical sum of the other two curves.

[6] If the E(M) curve is linear as drawn in Figure 1, growth leaves the difference M° - M* unchanged. If E(M) is concave (convex), the peaks of the pair of curves y(kM) and y(kM,

(Figure 1 about here)

4.2. A universal religion: the free-access model

Consider now an exclusive religion that grows in the way described by the previous model and becomes the dominant religion in the given society. At that stage, the religion has to face two problems. The first is that further expansion must address people less and less willing to join, i.e. an upward-sloping supply curve of members. The second is that the value of exclusivity is by now very low and benefits per member are falling. As we have seen, increasing doctrinal strictness is becoming an increasingly attractive option, to the extent that the religion has a theology that lends itself to such different degrees of strictness. In principle, there is no reason why the two problems could not be jointly solved: even though a stricter doctrine further discourages entrants, the organization can always choose the best degree of strictness that is compatible with the members supply constraint. In practice, however, this is unlikely to be the case: a religion that has become so dominant as to approach exhaustion of the available pool of recruits will likely have to bind itself by the obligation to take in all applicants, i.e. to grant free access on demand. If it previously was a universal religion in theory, it must now become a universal religion in practice, as happened to both early Christianity and Islam when each secured political power. Control of strictness can still be used to indirectly regulate membership levels and members' benefits, but in a setting in which direct control of admissions is no longer feasible. Put another way, for a dominant universal religion regulation of strictness becomes conditional on submitting to free access. To examine this problem, the model of unconstrained benefit maximization developed above is no longer appropriate and must be replaced by a free-access model.

The religious cooperative still maximizes per capita benefits as in (3), but is subject to the constraint that admission must be granted until benefits, y, equal the compensation, w, requested by applicants. The latter in turn is an increasing function of both the number of members, because the religion now faces the total relevant population, and the degree of strictness, because a stricter theology makes life, work, and especially careers within the religion more demanding, disagreeable, risky, or otherwise more costly. The inverse members supply function is thus:

E(M)) are drawn farther apart (closer to each other) as size expands, implying that exclusivity discourages entry more (less) than before, but in every case at a smaller gain in benefits.

$$w = w(sM, D) \qquad \text{with} \quad \frac{\partial w}{\partial M}, \frac{\partial w}{\partial D} > 0, \frac{\partial w}{\partial s} < 0, \frac{\partial^2 w}{\partial M^2}, \frac{\partial^2 w}{\partial D^2} \geq 0 \qquad (6)$$

where s is a parameter that captures exogenous shifts in members supply.

Since for a given level of strictness the number of members is set by supply via the free access constraint, the organization uses D to indirectly control the level of membership as it affects both the production of benefits and the compensation requested by entrants. The cooperative's problem is:

$$\max_{M,D} \quad y = y(kM, E(M), D) \quad s.t. \quad y(kM, E(M), D) = w(sM, D) \qquad (7)$$

The first-order conditions for this problem yield[7]:

$$\frac{k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}}{\frac{\partial y}{\partial D}} = \frac{s\frac{\partial w}{\partial M}}{\frac{\partial w}{\partial D}} \qquad (8)$$

$$y(kM, E(M), D) = w(sM, D) \qquad (9)$$

Equation (9) says that the free-access constraint is binding. Equation (8) says that the optimal levels of membership, $\hat{M}$, and strictness, $\hat{D}$, are such that the ratio of factors' marginal products equals the ratio of factors' marginal supply prices (i.e. marginal costs to the organization). It also shows that the MPs must have the same sign at the equilibrium: this sign will be positive if, given its productivity, the cooperative is constrained by a tight members supply so that positive returns to both M and D cannot be fully exploited, and viceversa for a negative sign.

If MPs are positive at the equilibrium, the supply of members is insufficient to achieve benefit maximization; in this case, a benefit-maximizing religion without free access would be similarly constrained and the equilibria of the two models would be identical. By contrast, if at the free-access equilibrium the MPs are negative, this implies that benefit maximization is unconstrained and free access forces the religion to go beyond the levels of membership and strictness that are chosen by the unconstrained cooperative, at which the MPs are zero (equations (4) and (5)). In other words, in this case the equality of benefits and supply price

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[7] The second-order conditions are given in the Appendix.

(equation (9)) occurs at input levels that are «excessive», i.e. higher than those which would maximize benefits in the absence of the free-access constraint.

Figure 2 illustrates the two types of equilibrium. The iso-benefits curves circle around the satiation point S, i.e. the full optimum described by equations (4) and (5). The curves w_1 and w_2 are two possible levels of the free-access constraint; they are concave if the supply function is strictly convex, linear if it is linear. At the equilibria A and B, the marginal rate of substitution between M and D in the supply function equals that in the benefit function, as described by equation (8). Free access implies that the equilibrium can never occur below the curve w, whether or not the religion would want it. At A, the religion does not produce enough benefits to attract more members; at B, it would like to dismiss some of the members and increase benefits but free access prevents that.

(Figure 2 about here)

Thus a universal religion will be stricter than an otherwise identical, unconstrained sect. This establishes the following proposition:

Proposition 3. An unconstrained benefit-maximizing, exclusive sect that becomes a universal religion with free access will at once increase both its membership size and its degree of strictness.

Turning to the comparative statics of the model, consider a change in s, i.e. an exogenous increase or decrease in the supply price of members[8]. If the MPs are positive or equal to zero at the equilibrium, clearly an increase in w (a reduction of members' supply) will involve a reduction in the use of both factors, M and D, and viceversa. But if the cooperative is forced to accommodate an «excessive» number of members - as will typically be the case under free access - so that the MPs are negative at the equilibrium, the situation is ambiguous. With an unchanged degree of strictness, the increase in w reduces the excess membership and thereby increases benefits; on the other hand, a reduction of strictness also increases benefits but at the same time encourages entry which in turn decreases benefits, while an increased

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[8] The comparative statics analysis that follows is conducted in terms of shocks on members supply for reasons of convenience only. An increase in s that decreases w in the members supply function is analytically equivalent to an increase in k that increases y in the benefit function; that is, in this model a parametric fall in members' supply has (almost) the same effects as a parametric fall in available resources or benefits.

strictness has the opposite effects. Clearly, the comparative statics derivatives can take on different signs.

We can establish the following proposition:

Proposition 4. When a universal religion bound by a free-access constraint has an excessive membership, the larger the excessive membership at the equilibrium, the more likely it becomes that an exogenous fall in members supply (an increase in w) will drive the religion to increase strictness and further curtail membership, ending up with higher benefits than before, provided that:

(a) the own elasticity of the marginal wage to the number of members, $M(\partial^2 w/\partial M^2)/(\partial w/\partial M)$, is sufficiently high (i.e. the inverse supply function is strongly convex in membership),

(b) the cross elasticity of the marginal product of strictness to membership, $M(\partial^2 y/(\partial D/\partial M))/(\partial y/\partial D)$, is sufficiently small in absolute value, and

(c) the members' aversion to strictness, measured by the additional wage required to compensate for a unit increase in D, $\partial w/\partial D$, is sufficiently small.

The proof is in the Appendix. The intuition is as follows. The first-order effect of a parametric upward shift of the members supply function is that both M and D fall. Since, however, membership was excessive at the initial equilibrium, its fall raises benefits, while at the same time it lowers the supply price of strictness. The rise in benefits and the fall in this supply price jointly make for a second-order effect of *increasing* strictness, which in turn further increase w, and hence compounds the initial fall in M, and at the same time decreases benefits somewhat (because both MPs were negative at the initial equilibrium). If this second-order effect is larger in absolute value than the first, the total effect of the exogenous increase in the wage will be an increased strictness and a strong reduction in membership. The larger the initial surplus membership, the more strongly negative its MP, the larger the upward shift of the y function when M falls and the smaller its subsequent downward shift when D rises. Since in a free-access equilibrium always y = w, a steep rise of $\partial w/\partial M$ (point (a) of Proposition 4) dampens the fall in y consequent on this downward shift of the y function. A small marginal supply price of strictness, $\partial w/\partial D$ (point (c)), helps to increase D when, following the initial fall in M, the y function shifts upward. Finally, a low complementarity of D to M (point (b)) is necessary because such interdependence tends to push the two factors to change in the same direction following a shock.

Figure 3 depicts the wage and benefits curves as a function of M (panel (a)) and as a

function of D (panel (b)). In both diagrams, point A is the initial equilibrium, B the first-order effect of the exogenous upward shift of both w functions to w', C the final equilibrium. As M moves from A to B in panel (a), y(D) moves to y" and w' to w" in panel (b). If D remained unchanged at A, nothing further would move in panel (a) and M would stop at B, but there would be a "profit" or surplus on D as its reward is now higher than its supply price. When D increases to point C, in panel (a) w' shifts up to w" and y(M) down to y", so that M further shrinks to C. As drawn, the downward shift of y(M) to y" is small and the upward shift of y(D) to y" is large because at the starting point A, $\hat{M}$ is very large and hence y(M) very steep. W(D) is linear and flat whereas w(M) is strongly convex, as stipulated above. Finally, the low marginal complementarity between factors is mirrored by the fact that, in both diagrams, the y curves are vertically nearly parallel to each other. As the figure shows, at the final equilibrium C, benefits are higher than at the initial equilibrium A.

(Figure 3 about here)

Summing up, when these conditions obtain, the optimal reaction to failure, exemplified by an exogenous loss of members, is for the religion to tighten its doctrine and internal discipline. As a result, the religion further shrinks in numbers and the benefits for remaining members are higher than before the shock. Extremism is here indeed the optimal reaction to failure.

5. Some historical evidence

5.1. Exclusivity and conversion

The first, basic class of evidence in support of our theory of conversion is that monotheistic religions which do not require exclusivity have usually *failed*. An example is the philosophical monotheism of the ancient world. Greek and Roman philosophers recognized that worship of the traditional gods was just superstition and that one higher entity must lie behind the multiplicity of creation, but as Cicero famously maintained, the traditional religion was good for law and order and therefore should not be challenged. Unsurprisingly, this philosophical monotheism never reached beyond a tiny literate elite. The same can be said of the modern counterparts of the ancient philosophers, the English and French deists and freethinkers of the 17th and 18th centuries up to Voltaire and Hume.

It could be countered that both the ancient and modern philosophers never aimed at a wide following nor offered a communal religious experience. But other quasi-monotheistic competitors of the early Christians, notably the Gnostics, the Mithraists, and the Manichees, were collective groups and engaged in active proselytism. Yet they lost out and in the end disappeared without a trace.

The philosophers' monotheism was mainly negative and polemical, as it stressed that, insofar as different religions emphasized differences that were illusory and concealed the simple, common truth behind them all, they were all wrong. Others, however, tried a more positive approach to this conciliatory program, emphasizing that the different religions are all right. The Baha'i religion was founded in Iran in the 19th century with the stated aim of reconciling all the monotheisms to a common worship of the one and only God. The Sikh religion was founded in early 16th century India to bridge the divide between Hinduism and Islam (Rama Krishna, 1933). Both were intensely communal and participatory, but given their basic assumption, neither prevented or discouraged its followers from participating in the traditional religions. In the end they both failed, becoming separate sects instead of meeting halls of the great established religions.

More speculatively, Buddhism arose in ancient India in opposition to the established Hindu polytheism, as a way to man's spiritual salvation beyond the bounds of the material world. In this, it was analogous to the Western monotheistic religions, while Hinduism was in many ways analogous to Greco-Roman polytheism. Thus the great Indian contest was in a sense a rehearsal of the Mediterranean drama. However, unlike its Mediterranean counterparts, Buddhism did not prohibit traditional Hindu worship; it only devalued it and stressed the benefits of its doctrine and practice for those willing to go over to monastic life. In the end, despite its impressive initial spread, Buddhism was completely wiped out of India proper. Outside force is not a sufficient explanation of this extinction: Muslim rule cracked down on all Indian religions but Hinduism and Jainism survived; furthermore, Buddhism also disappeared from South India which was never subject to Muslim rule. Conze (1960) suggests that this dismal fate had much to do with Buddhism's inherent weakness as a religion of renunciation - another way of stressing the non-exclusivity of Buddhism.

We noted in section 2 that if exclusivity is seen as a signal of high quality, then one should observe a positive correlation between the rate of conversion and the product assortment on offer on the religious market. In one of the very few quantitative studies of conversion, Bulliet (1979) finds that conversion to Islam in the medieval period reached a peak after the initial take-off and then slowly tapered off, so that the Muslim fraction of the population follows a logistic growth curve. Though admittedly this finding is compatible with

other interpretations as well, it also supports our theory - with the complication, however, that conversion to Islam in the Middle East occurred not from a pagan religious portfolio but from previous exclusive faiths, especially Christians.

An interesting by-product of the signaling approach to exclusivity is that it suggests a natural explanation, over and above the obvious rents from monopoly, for the final resort to state religion and state-enforced prohibition of competing cults, as observed in the late Roman empire. When most people are Christians, if there is a minimum critical mass for any religious firm to function, most such traditional cults are in disarray, so the opportunity cost - and hence the signaling value - of exclusivity is very low. Those who have not converted so far are even less likely to do so now. In the Roman case, these were the group who had the least interest in the collective religion and who, however, would be most valuable to the church as officials and bishops: the philosophical upper class. Harassing these people by proscribing their traditional worship was a way of lowering their opportunity cost of joining the church (Ferrero, 2004). By contrast, in the Islamic Middle East, where Islam came down from above instead of rising from below, the Christian communities were not so valuable to the new religion and so their cult was never proscribed.

A final, testable implication of the model is that as the exclusive religion becomes dominant, and the value of alternative religious products declines, it becomes possible and profitable to accommodate the pressure for asset diversification *inside* the new religion to a greater extent than before. Thus the cult of Mary, the cult of the saints, the cult of relics, and other forms of «polytheistic» worship within the framework of a monotheistic faith distinctly grew and multiplied after the Christian takeover of the Roman empire. Something of the same sort seems to have occurred in Islam in the medieval Middle East (Bulliet, 1979).

5.2. Radicalization as reaction to failure

5.2.1. D as Dar al-Harb: Islamic fundamentalism

Islam is a prototype of a behavior-based religion, so as explained above, there is little in the way of theology that can be made stricter when increasing strictness is in the religion's collective interest. Possibly the only important concept that lends itself to more or less strict interpretation is the distinction between *Dar al-Islam* (the house of Islam) and *Dar al-Harb* (the house of war): the first term stands for all the lands where a Muslim government rules and the *shari'a* is in force, the second for the rest of the world. The latter should be brought under

the rule of Islam through *jihad*, unless a «truce» is agreed upon and a country is classified as belonging in the *Dar al-Sulh* (the house of treaty). Conveniently, the scope for such middle ground can be, and has been, redefined in the course of history so as to allow flexibility in the waging of *jihad*. The key aspect for our purposes is that *jihad* in the «house of war» is not to be understood as conversion of *individuals* but as enforcement of the Law over a *society*; hence this form of strictness is not subject to diminishing returns to size and, just like strictness of theology, can be effectively applied even in a society that is virtually 100 percent Muslim.

The historical record suggests that the distinction of the two houses and the commandment of *jihad* was redefined in a stricter way, both in Islamic jurisprudence and political practice, in periods of failure or retreat (Berkey, 2003). After the initial wave of Muslim conquests, the imperative was relaxed under the Caliphate, until the Crusades in the 12th century and then the Mongol conquest in the 13th prompted a wave of theoretical and practical radicalization. Significantly, in that period, the notion became accepted that a lax, corrupt Muslim society was in effect non-Islamic and therefore a legitimate target of *jihad*. The long epoch of stability and security under Ottoman rule brought relaxation, which was in turn met by a revival of *jihad* under the banner of Wahabism in Arabia in the early 20th century. Finally, a dramatic resurgence and spread of fundamentalism has been under way worldwide over the last several decades, again in an international setting which is widely described by Islamic intellectuals and militant leaders as one of long-term political decline or retreat. Throughout the Muslim world, according to this view, governments and politicians have long been selling out basic principles by yielding to Western lure or pressure, watering down the implementation of the *shari'a*, fostering or at least allowing the secularization of society, engaging in self-serving deals with Western multinationals, governments, and international organizations, and otherwise corrupting what a principled Islamic political practice should be all about. This is exactly what one would expect in an all-Muslim society, as noted above. So apparently, in modern Islam radicalization is a response to perceived failure and retreat.

In our model of a universal religion under free access, failure was exemplified by an exogenous loss of members to alternative (secular) pursuits[9]. Proposition 4 predicts that radicalization may be an optimal reaction to failure if the members supply function is strongly

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[9] In a previous paper (Ferrero, 2005) I reached the same qualitative conclusions by working with a very similar model but with "failure" instanced by an exogenous fall in expected benefits, rather than a fall in membership. See that paper for an extended discussion of Islamist politics in the framework of the model.

convex in membership, if members show little aversion to strictness, and if increasing strictness does little additional damage to benefits. The first feature is natural in a one-religion society. The second and third can jointly be explained by the unique intertwining of religion and politics in the *umma*, the international Muslim community. Because to an observant Muslim the only rightful politics is the implementation of the *shari'a*, being radical means only going back to the sources of truth; it is not perceived as straying from mainstream Islam but, on the contrary, as being more truly and deeply Muslim. Therefore, even if many ordinary Muslims may well think an organization's current degree of strictness is excessive, they are likely to be forgiving as if these were «mistakes made for a good purpose». So extremist actions are received with a degree of indulgence, not to say sympathy, that has no parallel outside the Muslim world. On the part of the activists, turning more extreme «only» implies, or can pretend to imply, going back to precedent and certainty, blessed by some scholarly authorities. Thus militant fundamentalist organizations spring up, often competing with each other for support and each backed by some doctors of the Law, of whom there is every description. They tighten the norms of Islamic conduct and militancy, drive away the moderate or «hypocrite» Muslims by putting their willingness to take action to test, shrink to a selected, committed few, and reap the benefits of it. So far, it seems to have worked remarkably well.

5.2.2. D as Deliverance: revolutionary millenarianism

Besides *Dar al-Harb*, there are other possibilities for behavior-based religions, such as Judaism and Protestantism, to turn militant and aggressive. One instance in which the religion becomes political is revolutionary millenarianism (Lewy, 1974), a religious movement which holds that the kingdom of God on earth is coming soon, that the people must be cleansed and readied to properly receive it, and that its actuation depends on decisive action by the true believers. This occurred, among other cases, with the Zealots in the first Jewish revolt against the Romans in the years 66-70 AD, and in the radical wing of the German Reformation which culminated in the Anabaptist «kingdom» at Muenster.

(Add extended discussion here)

Our Proposition 4 can accommodate these types. First, millenarianism is predicated on the assumption that the true faith is in an extreme state of corruption and degradation, which is precisely what justifies the belief that the end of time and the day of deliverance are

at hand. Second, extremism takes the form of targeting fellow believers who have lapsed, or «apostates», because there are no more non-Jews or non-Reformed Christians around, respectively; so this line of action is immune to the decreasing-returns disease. And third, if one believes that the millennium is around the corner and that precipitating its consummation is a task incumbent upon the believer, then obviously aversion to strictness becomes minimal and, from the believer's point of view, the possible damage to «ordinary» religious benefits does not matter any more. The only thing that counts is that the elect, the «saints», be ready, and God shall scatter all their enemies.

5.2.3. D as Doctrine: the Roman Catholic church

Christianity was from the beginning uniquely suited to theological controversy and conflict due to the mind-boggling riddle of the doctrines of the Incarnation and the Trinity. This potential was fully exploited for the first time when Christianity became the universal religion of the Roman empire, through the unprecedented sequence of theological controversies from the council of Nicaea (AD 325) to that of Ephesus (431) to that of Chalcedon (451). As I argued at length elsewhere (Ferrero, 2004), the hardening of dogma was a rational response to the establishment of free access. This epoch-making historical change fully bears out the prediction of Proposition 3 of our model.

A quick survey of subsequent history strongly confirms that doctrinal radicalization was periodically resorted to as a response to threats to the church's grip on society. As the church secured its religious monopoly in the West, there followed a long period of relaxation of commitment and discipline and of corruption of both secular and regular clergy. Then in the 11th and 12th centuries, the growth of towns and trade threatened to seriously erode church support and open the door to competing movements. The reaction was manifold: the Crusades, the "Gregorian Reform", the all-out persecution of Waldensians, Cathars and other "heretics", the beginning of papal control over saint-making, the Benedictine reform, and the birth of the Mendicant Orders.

Relaxation and corruption over following centuries led to the Protestant Reformation and the wars of religion. The reaction was the Catholic Reformation: growth of dogmas, strengthening of the Inquisition, stricter discipline of believers' attendance to service and sacraments, birth of new, «specialized» religious orders (the Jesuits), and complete centralization of canonization procedures (Ferrero, 2002b).

After the Treaty of Westphalia, church monopoly was again secured over the Catholic countries, which ushered in another phase of relaxation. Then, at the dawn of the 19th century,

a sequence on unprecedented challenges began: the French Revolution, liberal movements, the «social question», socialism. The church's reaction was a new wave of dogmatic production, proliferation of specialized orders, and targeted saint-making until the early 20th century.

Finally, on Alice's principle that staying put amounts to sliding back, John Paul II's policies on all fronts can be read as radicalization in the face of increased denominational competition, secularization, and a dramatic fall of vocations to clerical careers.

As in the Islamic case, here again the broad pattern of events seems to fit the predictions of Proposition 4 surprisingly well. In the countries where Catholicism is the dominant religion, the supply of activists is naturally inelastic to benefits. Instead, the supply of strictness is elastic to benefits, i.e. activists are prone to it, because the church breeds a core of committed militants ready to heed its call. Finally, radicalization brings little damage to benefits and productivity when competition from other religions is effectively suppressed, so that disaffectioned believers have no alternatives. So the three main conditions for radicalization to be an optimal response to failure obtain. The differences with the Islamic case are that in the Catholic case doctrinal radicalization takes the place of *jihad*, and that church centralization implies that this radicalization is centrally directed and not the outcome of inter-sect competition.

By contrast, in countries like the U.S. where the Catholic church is subject to intense competition from other denominations and there is not as much in-breeding of zealots, the church has been, however grudgingly, pushed in the opposite direction: it perceives, rightly enough, that radicalization in the face of failure cannot be sustained in that setting.

6. A wrap-up

All universalistic religions subject to free access use the regulation of strictness or extremism to improve the benefits available to their members and officials.

The difference is between strictness in behavior and strictness in doctrine.

The suppression of dissent within the Catholic population is the price we pay for being spared aggressive extremism on their part.

Appendix

Proof of Proposition 2

Total differentiation of first-order conditions (4) and (5) in the text with respect to M, D, and k (assuming for simplicity $\frac{\partial^2 y}{\partial E \partial M} = \frac{\partial^2 y}{\partial M \partial E} = 0$, $\frac{\partial^2 y}{\partial E \partial D} = \frac{\partial^2 y}{\partial D \partial E} = 0$, $\frac{d^2 E}{dM dD} = 0$) yields the following comparative statics derivatives:

$$\frac{dM^*}{dk} = \frac{-\frac{\partial y}{\partial M}\frac{\partial^2 y}{\partial D^2}}{\frac{\partial^2 y}{\partial D^2}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right) - k\left(\frac{\partial^2 y}{\partial D \partial M}\right)^2} \tag{A1}$$

$$\frac{dD^*}{dk} = \frac{\frac{\partial y}{\partial M}\frac{\partial^2 y}{\partial D \partial M}}{\frac{\partial^2 y}{\partial D^2}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right) - k\left(\frac{\partial^2 y}{\partial D \partial M}\right)^2} \tag{A2}$$

The common denominator of these expressions is closely related to the second-order condition for problem (3):

$$\frac{\partial^2 y}{\partial D^2}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right) - \left(\frac{\partial^2 y}{\partial D \partial M}\right)^2 > 0 \tag{A3}$$

If k≥1, a sufficient condition for (A3) to be satisfied is that the denominator of (A1) and (A2) be greater than zero; if k≤1, then satisfaction of (A3) is sufficient to ensure that this denominator is greater than zero. Hence this denominator must be positive for a well-behaved problem. Given that by equation (4), $\partial y/\partial M > 0$ in equilibrium, and given that we assumed $\partial^2 y/\partial D^2 < 0$ and $\partial^2 y/(\partial D \partial M) > 0$, we conclude that both dM^*/dk, $dD^*/dk > 0$. By contrast, both derivatives would be equal to zero if E=0 and hence $\partial y/\partial M = 0$ in (4).

Second-order conditions for problem (7)

The bordered Hessian for problem (7) is required to be positive. Assuming again for simplicity $\frac{\partial^2 y}{\partial E \partial M} = \frac{\partial^2 y}{\partial M \partial E} = 0$, $\frac{\partial^2 y}{\partial E \partial D} = \frac{\partial^2 y}{\partial D \partial E} = 0$, $\frac{d^2 E}{dM dD} = 0$, and additionally $\frac{\partial^2 w}{\partial M \partial D} = \frac{\partial^2 w}{\partial D \partial M} = 0$, this is:

$$\left|\overline{H}\right| = -\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)\left[\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}\right)\frac{\partial^2 w}{\partial D^2} + 2k\frac{\partial^2 y}{\partial D\partial M}\frac{\partial w}{\partial D} - s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D^2}\right.$$

$$-\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)\left[s\frac{\partial^2 w}{\partial M^2}\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right)\right] > 0$$

(A4)

This implies that $\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)$ and $\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)$, which by first-order

condition (8) must have the same sign, must both be negative: if they were positive, which requires that both MPs ($k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}$ and $\frac{\partial y}{\partial D}$) be positive, both the square brackets in $\left|\overline{H}\right|$ would turn positive and (A4) could never be satisfied. Furthermore, the MPs may take on any sign, but if negative, they must not be inordinately large in absolute value.

Proof of Proposition 4

Total differentiation of first-order conditions (8) and (9) in the text with respect to M, D, and s, with the same simplifications as listed for the second-order condition for problem (7) above, yields the following comparative statics derivatives:

$$\frac{d\hat{M}}{ds} = \frac{-\frac{\partial w}{\partial s}M\left[\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}\right)\frac{\partial^2 w}{\partial D^2} + k\frac{\partial^2 y}{\partial D\partial M}\frac{\partial w}{\partial D} - s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D^2}\right]}{-\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)\left[\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}\right)\frac{\partial^2 w}{\partial D^2} + k\frac{\partial^2 y}{\partial D\partial M}\frac{\partial w}{\partial D} - s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D^2}\right]}$$

$$\frac{+\frac{\partial w}{\partial M}\frac{\partial y}{\partial D}\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)}{-\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)\left[s\frac{\partial^2 w}{\partial M^2}\frac{\partial y}{\partial D} + s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D\partial M} - \frac{\partial w}{\partial D}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right)\right]}$$

(A5)

$$\frac{d\hat{D}}{ds} = \frac{-\frac{\partial w}{\partial s} M\left[s\frac{\partial^2 w}{\partial M^2}\frac{\partial y}{\partial D} + s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D \partial M} - \frac{\partial w}{\partial D}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right)\right]}{-\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)\left[\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}\right)\frac{\partial^2 w}{\partial D^2} + k\frac{\partial^2 y}{\partial D \partial M}\frac{\partial w}{\partial D} - s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D^2}\right]}$$

$$\frac{-\frac{\partial w}{\partial M}\frac{\partial y}{\partial D}\left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)}{-\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)\left[s\frac{\partial^2 w}{\partial M^2}\frac{\partial y}{\partial D} + s\frac{\partial w}{\partial M}\frac{\partial^2 y}{\partial D \partial M} - \frac{\partial w}{\partial D}\left(k\frac{\partial^2 y}{\partial M^2} + \frac{\partial y}{\partial E}\frac{d^2 E}{dM^2}\right)\right]}$$

(A6)

For ease of reference, let us label the expressions in these equations in the following way:

$$\frac{d\hat{M}}{ds} = \frac{-\frac{\partial w}{\partial s} M[A] + \frac{\partial w}{\partial M}\frac{\partial y}{\partial D}(D)}{-(C)[A] - (D)[B]}$$

(A5')

$$\frac{d\hat{D}}{ds} = \frac{-\frac{\partial w}{\partial s} M[B] - \frac{\partial w}{\partial M}\frac{\partial y}{\partial D}(C)}{-(C)[A] - (D)[B]}$$

(A6')

The common denominator of these expressions is closely related to the bordered Hessian (A4) above. Subtracting this denominator from $|\overline{H}|$ we get:

$$\frac{\partial^2 y}{\partial D \partial M}\left[\left(\frac{\partial y}{\partial D} - \frac{\partial w}{\partial D}\right)s\frac{\partial w}{\partial M} - \left(k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM} - s\frac{\partial w}{\partial M}\right)k\frac{\partial w}{\partial D}\right]$$

(A7)

For $\partial^2 y/(\partial D \partial M) = 0$, the denominator and $|\overline{H}|$ coincide. For $\partial^2 y/(\partial D \partial M) > 0$, this difference is $\geq < 0$ iff $k \geq < 1$. If $k \geq 1$, (A7) ≥ 0, hence a positive denominator is a sufficient condition for $|\overline{H}| > 0$. If $k \leq 1$, (A7) ≤ 0, hence $|\overline{H}| > 0$ is a sufficient condition to make the denominator positive. Therefore we assume a positive denominator to ensure satisfaction of the second-order condition (A4).

Since by the second-order condition above both (C) and (D) < 0, a positive denominator implies that (A) and (B) cannot both be negative. Since all these expressions reappear in the numerators of (A5) and (A6), these signs are consequential. First, inspection shows that if the MPs ($k\frac{\partial y}{\partial M} + \frac{\partial y}{\partial E}\frac{dE}{dM}$ and $\frac{\partial y}{\partial D}$), which by first-order condition (8) in the text

must have the same sign, are ≥ 0 at the equilibrium, then both (A) and (B) >0; hence certainly $d\hat{D}/ds$ >0 and probably $d\hat{M}/ds$ >0 (provided $\partial y/\partial D$ is not inordinately large). Similarly, if MPs <0 but still both (A) and (B) >0, then certainly $d\hat{M}/ds$ >0 and probably $d\hat{D}/ds$ >0 (provided $\partial y/\partial D$ is not too strongly negative).

Secondly, the case of interest, $d\hat{D}/ds$ <0 and $d\hat{M}/ds$ >0, is guaranteed if (A) >0 and (B) <0, together with the implication that $\partial y/\partial D$ <0. The opposite result, $d\hat{D}/ds$ >0 and $d\hat{M}/ds$ <0, is not so guaranteed, however, if (A) <0 and (B) >0, because $\partial y/\partial D$ in both numerators works at cross purposes. This suggests that (B) <0 may be too strong a requirement and that a less stringent condition may still yield $d\hat{D}/ds$ <0 when both MPs <0. So we will require only (A) >0, which together with $\partial y/\partial D$ <0 yields $d\hat{M}/ds$ >0 with certainty, and examine the numerator of $d\hat{D}/ds$ in search of the conditions for it to be negative.

Examination of the numerator of (A6), keeping in mind that (C) <0, MPs <0, $\partial w/\partial s$ <0, shows that it is the more likely to be negative if (1) $\partial^2 y/(\partial D \partial M)$ is small, (2) $|\partial y/\partial D|$ is large, (3) $\partial^2 w/\partial M^2$ is large, (4) $\partial w/\partial D$ is small. Furthermore, we can calculate the partial derivative of the numerator of (A6) with respect to M; if it is negative, then the numerator decreases, and at some point turns negative, as M grows large at the equilibrium. Setting all third-order partials equal to zero, tiresome calculation yields the following sufficient set of conditions for this derivative to be negative:

$$(1) -M\frac{\dfrac{\partial^2 y}{\partial D \partial M}}{\dfrac{\partial y}{\partial D}} < 1/2 \qquad (2) M\frac{\dfrac{\partial^2 w}{\partial M^2}}{\dfrac{\partial w}{\partial M}} > \left(-\frac{\dfrac{\partial w}{\partial s}}{\dfrac{\partial w}{\partial M}} \right)\left(-M\frac{\dfrac{\partial^2 y}{\partial D \partial M}}{\dfrac{\partial y}{\partial D}} \right)$$

$$(3) M\frac{\dfrac{\partial^2 w}{\partial M^2}}{\dfrac{\partial w}{\partial M}} > -M\frac{\dfrac{\partial^2 y}{\partial D \partial M}}{\dfrac{\partial y}{\partial D}} \qquad (4) -\frac{\dfrac{\partial w}{\partial s}}{\dfrac{\partial w}{\partial M}} < -\frac{\dfrac{\partial y}{\partial D}}{\dfrac{\partial w}{\partial D}}$$

(A8)

These conditions together imply (a) $M\dfrac{\dfrac{\partial^2 w}{\partial M^2}}{\dfrac{\partial w}{\partial M}}$ large, (b) $-M\dfrac{\dfrac{\partial^2 y}{\partial D \partial M}}{\dfrac{\partial y}{\partial D}}$ small, (c) $\dfrac{\partial w}{\partial D}$ small, which proves Proposition 4.

Change in equilibrium benefits following a supply shock
The total change in y=w following a change in s can be found by calculating the total

derivative of function (6) with respect to s, taking into account the optimal adjustments of M and D to a change in s:

$$\frac{dw}{ds} = \frac{\partial w}{\partial s} M + s \frac{\partial w}{\partial M} \frac{d\hat{M}}{ds} + \frac{\partial w}{\partial D} \frac{d\hat{D}}{ds} \qquad (A9)$$

The sign of this expression is ambiguous. Using (A5), (A6), first-order condition (8), and the labels from (A5') and (A6'), the sign of (A9) turns out to be the same as that of the following expression:

$$(A)\left(k \frac{\partial y}{\partial M} + \frac{\partial y}{\partial E} \frac{dE}{dM} \right) + (B) \frac{\partial y}{\partial D} \qquad (A10)$$

If the MPs ≥ 0, which implies that (A) and (B) are both >0 (see above), then this expression is also ≥ 0 respectively. If the MPs <0 but still both (A) and (B) >0, then (A10) <0. If the MPs <0 and (B) <0, then (A10) may take on any sign. Analysis of expression (B) shows that a necessary, though not sufficient, condition for (B) to be negative is $\dfrac{\frac{\partial^2 w}{\partial M^2}}{\frac{\partial w}{\partial M}} > -\dfrac{\frac{\partial^2 y}{\partial D \partial M}}{\frac{\partial y}{\partial D}}$,

which was found above to be one of the sufficient conditions for Proposition 4 to hold (condition (3) in (A8)). Thus when Proposition 4 holds, nearly always $dw/ds < 0$, i.e. an exogenous rise in the wage will finally result in higher benefits.

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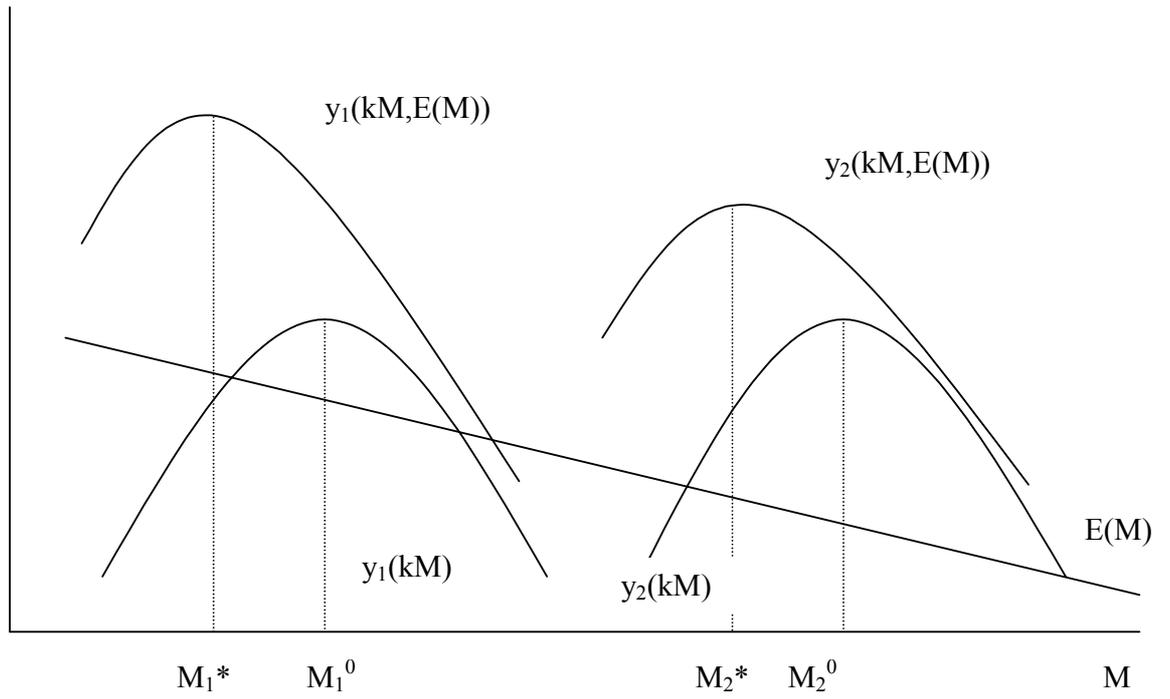
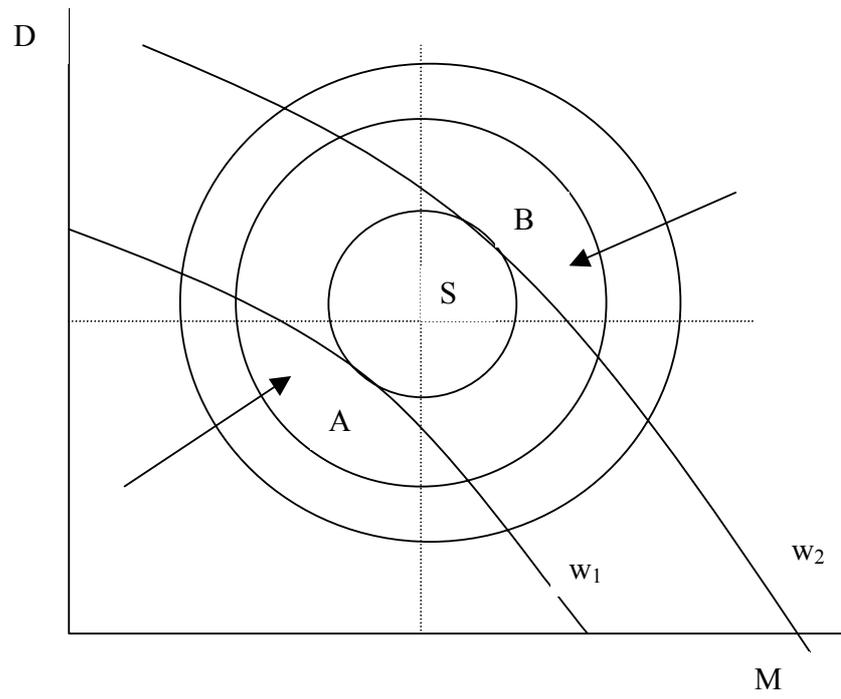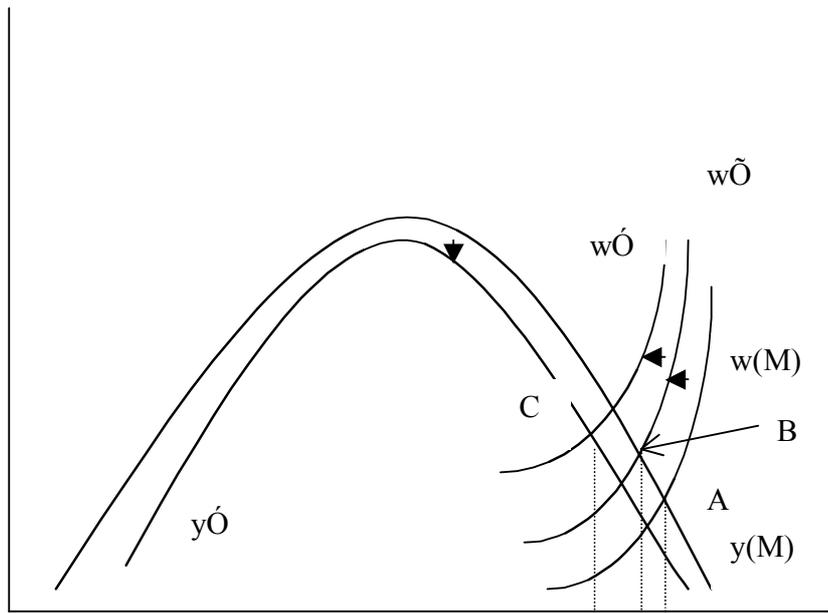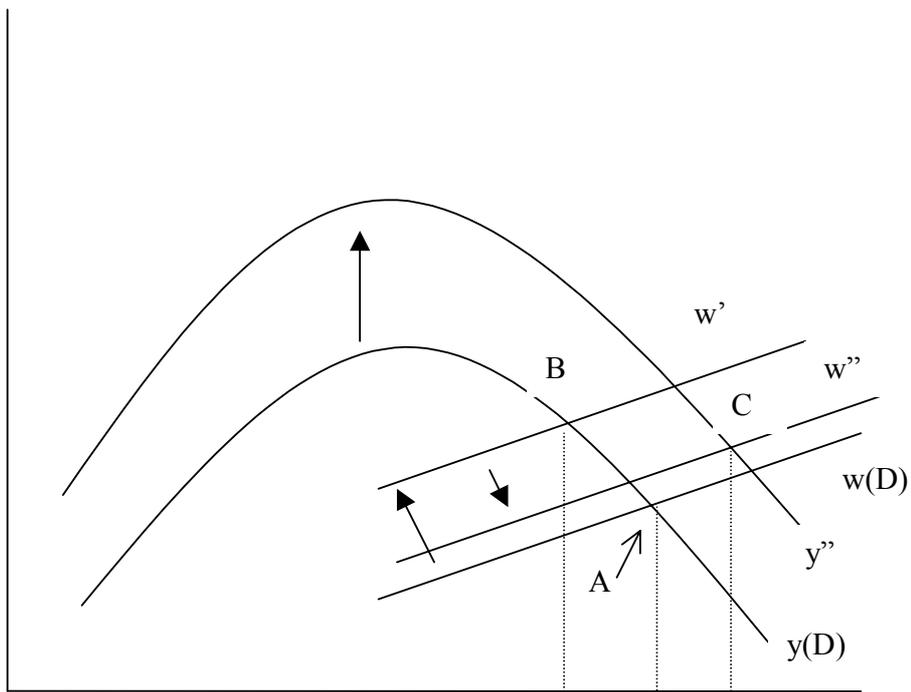Figure 1. Signaling effect of exclusivity and growth.

Figure 2. Free access equilibria.

Figure 3. Extremist reaction to failure in a universal religion