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ABSTRACT

Weak states enable private enforcement but it does not always fade away in the presence of strong states. We develop a general equilibrium model of the market organization of enforcers (self-enforcers, competitive specialized enforcers or monopoly) who defend endowments from predators. We provide conditions under which a Mafia emerges, persists and is stable. Mafias are most likely to emerge at intermediate stages of economic development. Private enforcers might provide better enforcement to the rich than would a welfare-maximizing state - hence the State may find it difficult to replace the Mafia or competitive private enforcers.

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Private enforcement of property rights arises where state enforcement is weak. Our reading of history suggests that Mafias– such as the Sicilian Mafia, the Japanese Yakuza and contemporary Russian gangs– are coalitions of enforcers.[1] Yet a weak state does not always produce Mafias, and strong states do not always eliminate Mafias. Enforcement market structure ranges from Wild West self-enforcement through specialized competitive enforcement to monopoly. What factors explain market structure, especially the emergence or disappearance of Mafias? Is state enforcement preferable to specialized private enforcement? For whom?

We provide a general equilibrium model of enforcement and its market organization in a setting where predators attack the endowments of consumer/owners who choose between self defense and the available forms of specialized enforcement. Self enforcement is always feasible, so the gain from self enforcement puts an endogenous bound on the price which specialized enforcers can charge. The volume of predation and specialized enforcement and its market organization are all endogenous. Within this framework we analyze two alternative market structures for private enforcement: competition and monopoly. In this setting we explain two important puzzles about monopoly persistence in the market for enforcement. First, why is a Mafia monopoly typically able to defeat defection by its members on the one hand and entry by rivals on the other hand? Second, why does the evolution of strong states face apparent difficulty in displacing Mafias from the enforcement of legal rights?

For simplicity, we abstract from many details of particular Mafias and many elements of real economies. The only productive activities in the model are the receipt of endowments by consumer/owners and the enforcement of rights to the endowments against predators. Our exclusive focus on the enforcement of legal property rights is appropriate because this is what legitimizes new born Mafias.[2] The property to be defended is a spectrum of local endowments to individuals (think of livestock in the Sicilian case, retail goods in the urban shopkeepers case). Property is attacked by predators (thieves). Some property owners may opt for self defense, others buy enforcement from a local specialized enforcer. The region contains many such locales. The predators and local monopolistic enforcers spread

[1]See Section 1 for details.

[2]See Section 1 for more discussion. See Anderson and Bandiera (2001) for the analysis of Mafia protection of an endogenous volume of exchange.

themselves throughout the region of property owners. In the competitive mode of enforcement, the number of specialized enforcers in the region determined in a spatial monopolistic competition model. The monopoly mode of enforcement (the Mafia) is a coalition of local specialized enforcers which optimizes the size of its membership. The coalition could, in principle, dictate the pricing/service policies of its members, but we follow the existing evidence which suggests that Mafia coordination of enforcement is quite limited, resembling the cooperation of neighboring police departments. [3]

The equilibrium market structure of enforcement — Mafia, competitive or self-enforcement — is related to the real income of productive agents. Intuition and casual empiricism suggest that predation and enforcement are countercyclical and will fall with secular growth. However, very poor regions do not usually have Mafias. Consistent with this observation, we show in a simulation of our model that passing from low development (low opportunity cost of predators) to high development (high opportunity cost of predators), the market structure switches from a stage with no Mafia to a stage with Mafia enforcement and then switches back to a stage with no Mafia again.

Given conditions favorable to Mafia existence, our model gives *economic* reasons why the Mafia coalition is stable.[4] On the one hand, existing members have little incentive to defect given that they are free to optimize on their price/service policies. On the other hand, the Mafia forestalls breakup from competitive entry by maintaining excess capacity in the form of Mafia hangers on.

Once the Mafia coalition has gained monopoly power in the enforcement market, we shows that it pays to use such power for extortion. That is, the Mafia always has an incentive to prey on unprotected properties to raise the demand for its services. Genuine enforcement and extortion are thus complementary activities for the Mafia coalition.

Mafia persistence in the presence of strong democratic states (for example, Japan) may be explained by political economy in our model. The

[3]We also ignore in this paper the nonenforcement activities of the individual Mafia members. In reality individual members exploit their reputation to engage in other, mostly illegal, activities.The evidence suggests that these are not coordinated from the center, however, and hence they are not properly Mafia activities in our view. A good analogy of our view of the Mafia is a franchise operation such as McDonald's, which protects its brand and optimizes the number of franchises.

[4]Social norms may help sustain the coalitions too.

welfarist state cares about the poor who cannot afford or be afforded enforcement. The poor suffer a negative externality from the predators deflected from protected onto unprotected property. Private enforcers and their rich customers neglect this externality and do better without state enforcement. The Mafia (and *a fortiori* competitive enforcers) may choose also to protect a higher fraction of property than the welfarist state. In this case, a state which attempts to substitute its optimal policy for private enforcement may fail because all its potential customers, the high value property owners, prefer the Mafia — *cream skimming* in the enforcement business.

Our analysis has important policy implications. Our view implies that, as coalitions of enforcers, Mafias have ambiguous effects on welfare. As they enforces legal activities, they may be beneficial; providing what the state cannot. But as the state grows more capable, the Mafia's potentially excessive enforcement of high value legal property makes its presence undesirable. Where the activity is illegal (drugs), Mafia enforcement may cause undesirable expansion. In this paper the Mafia affects only the distribution of the property between the owners and the predators due to our assumption of a fixed supply of property. In our sequel paper we model the Mafia's enforcement of exchange, featuring the expansion of activity under Mafia enforcement.

Section 1 provides context for our paper. We review the historical descriptive evidence on Mafias and the recent formal economic literature on predation and Mafias. Section 2 sets out the basic elements of the model and derives the competitive enforcement equilibrium. Section 3 derives the Mafia equilibrium. Section 4 considers the formation and stability of the Mafia coalition. Section 5 analyzes the Mafia's incentive to engage in extortion. Section 6 contrasts the Mafia equilibrium with a welfare-maximizing state enforcement policy. Section 7 concludes.

1 Context

The view of Mafias as enforcers was proposed by Schelling (1984) and richly elaborated by Gambetta (1994). The available historical evidence suggests that originally Mafias were coalitions of guardians who provided enforcement of legitimate rights. Mafias typically developed after major property rights reforms that were not matched by the establishment of adequate formal enforcement mechanisms. The Sicilian Mafia emerged soon after the abolition of feudalism (1812-1840) when private property was created, land ownership became more diffused and there was no formal authority to protect the newly established rights (Bandiera, 2000; Gambetta, 1994). Absentee landowners and fragmentation of landholdings brought no fixed settlement on the land, hence the landlords and their rootless tenants were weak relative to the predators who would prey on their farms. (Tenants would not risk much to defend property not their own. Landlords were usually not present to defend their property.) Security guards who formerly had been hired by feudal lords to patrol their large estates offered to provide protection to the new landlords. Enforcement was at first a competitive activity; each Mafia family operated in its own territory with little interaction among each other (see Gambetta, 1994). Eventually, coalitions formed. Similarly, the rise of the yakuza in Japan coincided with two major property rights reforms. The first was implemented during the Meiji period (1868-1911) when feudalism was abolished and a modern property rights regime was put into place; the second took place during the Allied Occupation after World War II when new rights were established and land was redistributed further. In both cases the reform was not matched by effective formal enforcement bodies. For example, the police were dismantled by the Allied Forces and were thus unable to maintain public order (Milhaput and West, 1999; Hill 2000). The Russian Mafia also emerged when, as a consequence of privatization and the collapse of the communist regime, private ownership became more widespread, property rights legislation was inadequate and public enforcement highly ineffective (Varese 1994).

Once their reputation is established, Mafias typically branch into the enforcement of illegal deals within legal markets and into the protection of illegal activities. We abstract for simplicity from these important activities. The existing evidence suggests that, for instance, the Sicilian and American Mafia are actively involved in sustaining cartel arrangements between firms in sectors as diverse as construction, transport and vegetable wholesale (see Gambetta and Reuter 1995). Similar evidence exists for Japan (Woodhall 1996). Finally, Mafias act as governments in the underworld, that is they collect taxes in exchange for governmental services such as dispute settlement, contract rights enforcement but also protection from competitors and from the police (Firestone 1997). Interestingly, there is evidence that gangs operating in low income areas of US cities play a role similar to that of the major organized crime groups. Akerlof and Yellen (1994) report that gangs perform government-like functions both in illegal and legal markets within their territory. Gangs control drug-dealing but they also protect residents from theft and violence by other gangs. That residents often prefer gang services to police services where the police are perceived to be ineffective and/or unfair suggests that, just like Mafias, gangs rise when there is no adequate formal enforcement mechanism. Compared to Mafias, however, gangs have so far failed to form a coalition and they are more akin to monopolistically competitive firms differentiated on the basis of location.

Private enforcement of property rights and the analysis of organized groups have recently been formally analyzed in the economic literature. deMeza and Gould (1992) analyze decentralized enforcement of property rights. They show that individual choices might be socially inefficient in the sense that either too much or too little enforcement is provided in equilibrium. Konrad and Skaperdas (1999) add to the analysis of decentralized enforcement by exploring four alternative market structures: individual enforcement (as in deMeza and Gould (1992)), collective enforcement (where individuals cooperate to provide enforcement), enforcement by a private, profit-maximizing monopolist and finally enforcement by a set of competing private enforcers. They show that the latter is the most stable market structure. Compared to these works, our paper carries the analysis of market structure one step forward. We allow competing enforcers to form a coalition which, as suggested by the empirical evidence, controls membership size but, unlike a monopolistic enforcer, does not the pricing policies of its members. That the coalition only controls the size of its membership guarantees stability, as argued in section 4 below. In line with deMeza and Gould (1992) we find that the amount of protection offered by private enforcers is socially inefficient.

Dixit (2001), Grossman (1995), Polo (1995) share our view of Mafias as enforcers and analyze issues complementary to those discussed in this paper. Dixit (2001) analyzes enforcement of contract, rather than property, rights. He develops a dynamic model in which each period pairs of individuals are randomly matched and make transactions that cannot be legally enforced and in which cooperation cannot be sustained by reputation alone. He shows that a profit-motivated private intermediary can provide enforcement, albeit not socially optimal enforcement, in equilibrium. Grossman (1995) analyses the interaction between the Mafia and the State when both institutions provide revenue-maximizing property rights enforcement. He show that as long as the State remains viable (i.e. Mafia activity is not too disruptive), the presence of an alternative enforcement agency increases citizens' welfare because it reduces the monopoly power of the State and hence its rent-extraction capability. Polo (1995) analyses the incentive structure and the internal organization within a single group, e.g. within a single Mafia family and shows how incentive costs determine the optimal group size.

Finally Skaperdas and Syropoulos (1995) analyze the origins of Mafia-like groups in the context of a model in which there is no State to enforce property rights and agents must decide how to allocate resources between productive and appropriative activities. Productive activities generate output while appropriative activities only determine its distribution. They argue that agents with a comparative advantage in appropriative activities will rule by coercion. In contrast, we maintain that the main function of Mafias is to sell enforcement *against* predation instead of being primarily engaged in it. Mafias as enforcers are commonly viewed as extorters — offering protection from the Mafia's own violence. In our model, extortion is at most an enhancement of the Mafia's enforcement business rather than the basis of it (see Section 5).

2 Competitive Enforcement

Property owners, specialized enforcers and predators interact in the market for enforcement. This interaction is rich with externalities: specialized enforcement deflects predators onto self-defended property, additional specialized enforcers raise the success rate of incumbent enforcers against a given supply of predators, and additional predators raise the success rate of incumbent predators.

Specialized enforcers interact in monopolistic competition because the reputation and capability of a local enforcer reaches only over short distances. Taking Western Sicily as our motivating example, villages are distributed throughout the region and the enforcers locate in the main villages. We abstract from intervillage differences and any irregularities of geography. Predators spread themselves across the region to equalize their rate of success. In long run equilibrium the number of enforcers suffices to drive profits to zero.

2.1 Competitive Enforcement Model

Assume that buyers of unit mass are uniformly located on a unit circle and at each location on the circle there is an identical distribution of property ranked from high to low value. The buyers' valuation of property at each location is thus distributed according to $V(\alpha)$, where α is the proportion of buyers on the radial section with valuation greater than or equal to V, and $V_\alpha < 0$.[5] This model of valuation can be rationalized in several other ways, but ours is simple and plausible.

If enforcement is purchased, the buyer's subjective probability of enjoying his property is equal to π'. If he does not buy enforcement his subjective probability of enjoying his property is equal to β'. For specialized enforcement to be purchased at all, $\beta' < \pi'$. The value of enforcement to the marginal buyer is $(\pi' - \beta')V(\alpha)$. The value of each property is known only to its owner, but enforcers and predators know the distribution of values. All buyers with valuation greater than or equal to $(\pi' - \beta')V(\alpha)$ will buy enforcement when the enforcer charges a price equal to $(\pi' - \beta')V(\alpha)$. Inframarginal property owners enjoy a surplus. The assignment of buyers to an enforcer at each location is unique when a collection cost increasing in distance is added. The cost is assumed to be tiny to abstract from further accounting.

All property is subject to attack by predators of mass B (for Bandits). The predator knows whether property is protected or not, which gives him information on its expected value. The predators share the common beliefs so those who choose to attack random pieces of unprotected property have a subjective probability of successful stealing equal to $1 - \beta'$, and those who choose to attack random pieces of protected property have a subjective probability of stealing equal to $1 - \pi'$.

We analyze the symmetric equilibrium of our spatial structure. Thus B/n of the predators' mass is located in each enforcer's market area and $1/n$ of the property owners'mass is located in each enforcer's market area, while a fraction α^* of properties are protected. This is consistent with rational expectations, as we now show.

At each location the objective probability of successful self-enforcement

[5] If the property distribution is uniform, the buyers are distributed on the unit cone with the top of the cone having the highest value property. For other valuation distributions, all horizontal cross sections remain circular with radii which decrease with height, but the cone may be distorted vertically so that the radii need not decrease linearly.

depends on the relative numbers of self-enforcers and predators. The prey have some capacity to evade the predators through hiding their goods, moving them about or coordinating warnings. We assume plausibly that in this anonymous hide-and-seek interaction the success rate depends on the ratio of the numbers on each side.[6] Specifically, the realized (objective) probability of successful ownership is equal to

$$\beta = \frac{1}{1 + \theta^{\frac{B(1-\lambda)/n}{(1-\alpha)/n}}} = \frac{1}{1 + \theta B \frac{1-\lambda}{1-\alpha}}. \tag{1}$$

Here λ is the fraction of predators who choose to prey on protected property. Thus $B(1-\lambda)/n$ is the mass of predators who choose to attack unprotected property on each market segment. Similarly $(1-\alpha)/n$ is the mass of unprotected property owners in each market segment. Then $B\frac{1-\lambda}{1-\alpha}$ is the average intensity of predator to prey on unprotected property. θ is a technological parameter reflecting the relative effectiveness of predator to prey activity on unprotected property. Equation (1) implies that, if θ is equal to 1, and the mass of predators and unprotected property owners is equal, the probability of successful evasion is equal to 1/2. A rise in θ lowers the probability of successful evasion as predators become relatively more effective. Finally, as is plausible, β is increasing in α, decreasing in λ and homogeneous of degree zero in (α, λ). Note the important negative externality inflicted by those who purchase enforcement on those who do not: $\partial\beta/\partial\alpha < 0$. Intuitively, those who buy enforcement deflect thieves onto those who do not, lowering their probability of successful defence.

The realized probability of successful ownership when protected by the specialized enforcer is assumed at each location to be equal to

$$\pi = \frac{1}{1 + \theta B \frac{\lambda/n}{R}}. \tag{2}$$

Here θ is a parameter reflecting the relative effectiveness of offensive technology to the enforcement technology of enforcers, $B\lambda/n$ is the mass of

[6]In contrast, the conflict literature (e.g., Grossman, 1995; Skaperdas and Syropoulos, 1995) models interaction of one predator and one prey as a contest, with success determined by predetermined force levels which are optimally chosen at an earlier stage. The anonymous interaction model is distinct because (i) agents are probability takers and (ii) success depends on relative numbers due to interaction in which one side seeks and the other side hides.

predators who choose to attack protected property in each market, while R represents the enforcement capability of the enforcer to deter attack or to recover the value taken by predators who choose to attack. (Any difference between the technology of self protection and specialized protection is subsumed into R to conserve notation.) This assumption is a very convenient simplification of a reduced form which compounds two activities. First, protected property owners continue to rationally evade predators at no cost. Second, the specialized enforcer acts to pursue predators and recover their loot. By appropriately restricting the functional form of the probability of recovery, we derive as a convenient reduced form equation (2).[7] The number of protected properties (α) affects the probability of successful defense indirectly through its effect on the number of predators that attack protected property (λ).

In rational expectations equilibrium, the subjective value of β' must be equal to the realized value of β in the interaction of predators and prey and subjective value of π' must be equal to the objective performance of the enforcer π. The property owners are probability takers, as is plausible when they are in large numbers. The anonymous group of predators of size $B\lambda/n$ cannot affect their success rate by their preparations due to their individual anonymity, so they are probability-takers as well. In contrast, the enforcer is not anonymous because there is only one enforcer on each market segment and the property protected by the enforcer is identified to the predators. [8]

[7]The success rate of protected property owners is given by a compound of the probability of evasion and the probability that the specialized producer recovers stolen goods. The latter is formed by allowing the 'parameter' γ to reflect the relative effectiveness of offensive and protective effort in specifying the probability of a recovery of stolen goods:

$$\begin{aligned}\pi &= \frac{1}{1+\theta B\frac{\lambda}{\alpha}} + \left[1 - \frac{1}{1+\theta B\frac{\lambda}{\alpha}}\right]\frac{1}{1+\gamma B\frac{\lambda}{nR}} \\ &= \frac{1}{1+z}, \quad z \equiv \frac{\theta B\lambda}{nR}\frac{\gamma B\lambda}{\alpha+\theta B\lambda+\alpha\gamma B\lambda/nR}.\end{aligned}$$

Define the implicit function $\gamma(B, \alpha, \lambda, nR)$ which will set the second ratio equal to 1 always. It can be shown that this function and the resulting probability of recovery of stolen goods have reasonable properties in α, λ, B and nR.

[8]The single enforcer in principle knows he affects his success rate by his capacity R. We simplify by assuming that R is fixed for any individual enforcer, noting that it can be shown that endogenous choice of R turns out to add no new inisght. In contrast, when

The enforcers maximize profits by selecting the optimal proportion of customers in their area to serve, α. They cannot price discriminate because they cannot observe the valuations of their customers.[9] The enforcer incurs a cost f of establishing capability R.[10] The enforcer's choice problem is:

$$\max_{\alpha} \frac{\alpha}{n}(\pi' - \beta')V(\alpha) - f. \tag{3}$$

The enforcer has market power through realizing that $V(\alpha)$ is declining in α. There are two other channels of market power which we suppress. First the share of protected property affects the success rate on unprotected property (β is decreasing in α). Second, the share of protected property affects the returns to attacking both protected and unprotected property and therefore determines λ, i.e. the share of predators who attack protected property. Thus an enforcer with full sophistication replaces $\pi' - \beta'$ with $\left[\frac{1}{1+\theta B\frac{\lambda/n}{R}} - \frac{1}{1+\theta B\frac{1-\lambda}{1-\alpha}}\right]$ in the optimization problem. We assume the enforcer takes the probability β' as exogenous because it reflects the equilibrium interaction of anonymous predators and unprotected property owners across, in principle, the entire region.[11] We assume the enforcer plays Nash against the predators, taking the number of predators $\lambda B/n$ as given. Since reputation R is fixed, this means π is exogenous. Our probability-taking

we consider the Mafia coalition of enforcers, a key element of the problem is that the organization optimally selects the aggregate force level nR with which to oppose the set of predators λB, taking account of its effect on the contest success rate π.

[9]This assumption is an inessential detail — perfect price discrimination allows the enforcer to obtain all the buyers' surplus but the remainder of the model is similar.

[10]The capacity cost plausibly varies with the number of predators the enforcer has to deal with, but we assume the enforcer plays Nash against the predators and thus takes the mass of predators as given. The number of predators the enforcer has to deal with is λ/n, equal to the probability that a protected property will be attacked, $\frac{\lambda/n}{\alpha/n}$times the number of protected properties α/n. We suppress any other effect of the volume of protected property such as collection costs which might rise with the number of customers in specifying the cost of reputation f.

The cost reflects the enforcer's exogenous opportunity cost outside the region (which may be the same as the predators' opportunity cost), but may also include added elements specific to enforcement (the need to establish a reputation requires investment).

[11]In equilibrium of course, as $B(1-\lambda)/n$ predators attack the $(1-\alpha)/n$ unprotected properties on his segment, the interaction on his own market segment is the same as that anywhere else. A sophisticated enforcer might understand the equilibrium and hence be able to optimize the effect of α on β while assuming that all other enforcers would similarly optimize the effect of α on β on their market segments.

enforcer will in Nash equilibrium have his expectations realized, $\pi' = \pi$ and $\beta' = \beta$. Thus the optimal proportion of property owners served, α^*, is determined by:

$$\frac{(\pi - \beta)}{n} \left[V(\alpha^*) + \alpha^* V_\alpha (\alpha^*)\right] = 0. \tag{4}$$

With free entry by competitive enforcers, there are zero profits, so the number of enforcers n adjusts such that:

$$\frac{\alpha^*}{n} \left[\pi - \beta\right] V(\alpha) - f = 0. \tag{5}$$

We assume that f is invariant to n, rationalized by infinitely elastic supply of enforcers from outside the region at a fixed opportunity cost.

The proportion of predators, λ, who attack protected property is determined by the equality of expected return in attacks on the two types of property:

$$[1 - \beta] \underset{x \geq \alpha^*}{E} [V(x)] = [1 - \pi] \underset{x < \alpha^*}{E} [V(x)], \tag{6}$$

where the left hand side of the equation is the return from attacking unprotected (low value) property and the term on the right is the expected return from attacking protected (high value) property, and $E[.]$ is the expectation operator.[12] It is convenient to deploy compact notation for the average high and low value properties:

$$\begin{aligned} V^H &\equiv \underset{x < \alpha^*}{E} [V(x)] \\ V^L &\equiv \underset{x \geq \alpha^*}{E} [V(x)]. \end{aligned}$$

Finally, the mass of predators B includes all agents whose alternative option is worse than the expected payoff from predation. Normalizing the maximum potential number of predators to one and assuming that alternative options are uniformly distributed on $[0, w]$ we have:

$$B = \frac{(1 - \beta) V^L}{w} \tag{7}$$

[12]We abstract from punishment of predators who are caught preying on protected property, without loss of generality. With a sufficiently harsh punishment, no predators will ever attack protected property. For less harsh punishments, the effect of the size of punishment is simply to raise the equilibrium π and lower the equilibrium β without changing any qualitative properties of the system.

The full equilibrium of the system is reached when the predators allocation condition (6), the predators' entry condition (7), the enforcer's choice of customers (4) and the free entry condition (5) are all satisfied with the anticipated probabilities being equal to the values implied by the contest success functions (2) and (1). This 6 equation system determines $(B, \lambda, \alpha, \pi, \beta, n)$.

2.2 Existence and Uniqueness of Equilibrium

We are mainly interested in interior equilibrium. If it exists, we are interested in sufficient conditions to guarantee that it is unique among the symmetric equilibria. It is possible that no interior solution exists, and either $\alpha^* = 0$ (no enforcement is offered) or $\alpha^* = 1$ (all property is protected). The no enforcement case is more likely as fixed costs are high relative to willingness to pay while the full enforcement case arises when the elasticity of demand remains sufficiently far above one throughout the range of α.[13]

In the Appendix we prove:

Proposition 1 *For $V(0)/f$ sufficiently large and $V(1)/f$ sufficiently small, and $w < \frac{\theta V^L}{(1-\alpha^*)}$; specialized enforcement is offered in symmetric equilibrium to a unique fraction of property α^*.*

When $w \geq \frac{\theta V^L}{(1-\alpha^*)}$, the solution is ($B^* = n^* = 0$, $\pi^* = \beta^* = 1$), which implies that there will be no predators and no demand for enforcement.[14] When $V(0)/f$ is too small, no specialized enforcer can break even. When $V(1)/f$ is too large, all property is protected.[15]

[13] We avoid complex questions of the origin of reputation in a dynamic setting by assuming expenditure of f creates a capabilty R which results in anticipated reputation for effectiveness modelled as above. Reputational models generally have multiple Nash equilibria. A zero enforcement equilibrium obtains if enforcers have no reputation, buyers expect their services to have no value, hence they never buy protection and the enforcers never have the opportunity to demonstrate their ability and thus create a reputation. Symmetrically there is always a zero predation equilibrium: if predators expect to always fail, they never attack and hence never discover that they could be successful. History such as that of 19th century Sicily tells us that initial conditions matter in creating reputation.

[14] The condition is evaluated at α^*, because if any protection were to be offered it would protect that fraction of property.

[15] The objective probability β is undefined since $\alpha = \lambda = 1$. The equilibrium depends on the expectations of self-defense success β'. There are two cases: if property owners and

2.3 Comparative Statics

The model of private enforcement equilibrium has interesting comparative statics, summarized in Table 1. Besides the parameters presented above, we allow for a multiplicative shift v in the property value function.

TABLE 1

	$d\beta$	$d\pi$	dB	dn
dw	+	+	-	-
$d\theta$	-	-	+	+
dR	+	+	-	-
df	-	-	+	?
dv	-	-	+	+

If alternative opportunities worsen (w falls), if predators become more effective (θ increases) or if property value increases (v increases) there will be more predators (B increases) but also more enforcers (n increases) in equilibrium. Intuitively, since there are more predators both protected and unprotected property is less safe (both π and β fall), yet β has to fall more than π in order to keep the allocation constraint (6) satisfied. It follows that, given α^*, the price of enforcement is higher, which makes more enforcers enter the market.

If enforcers become more effective (i.e. R increases), there will be fewer predators but also fewer enforcers in equilibrium. Intuitively when enforcers are more effective protected property is safer. To satisfy the allocation constraint unprotected property must also become safer otherwise we end up in the corner solution where predators attack only unprotected property. Given that β increases more than π, the price of enforcement is lower and this drives enforcers out of the market.

Finally if the fixed cost of enforcement increases there will be more predators in equilibrium, property (both protected and unprotected) will be less safe and the effect on the number of enforcers is ambiguous. Intuitively

predators are pessimistic about the effectivness of their self-defense and $\beta' < \frac{Rw-\theta f}{Rw}$ there is an interior solution with $\pi = \frac{Rw\beta'}{Rw-\theta f}, B = \frac{(Rw(1-\beta')-\theta f)V(1)}{Rw-\theta f}, n = \frac{\beta'\theta V(1)}{Rw-\theta f}$. This solution exists as long as $Rw-\theta f > 0$. Alternatively, if property owners and predators are optimistic about self-defense ($\beta' > \frac{Rw-\theta f}{Rw}$), the equilibrium is at $\pi = 1, B = 0, n = V(1)\frac{1-\beta'}{f}$

we expect n to fall as f increases. When this happens, though, both π and β fall. As explained above, β has to fall more than π in order to keep the allocation constraint satisfied. It follows that, given α^*, the price of enforcement is higher, which has a countervailing effect on the number of enforcers in equilibrium.

The equilibrium solution is homogeneous of degree zero in v, w, f; respectively property valuation and the outside options of predators and enforcers. We regard economic development in the context of our model as a rise in w relative to v or f, as reflecting real income increases of a non-property owning class.

3 The Mafia Coalition

The Mafia is a coalition of the enforcers that limits its numbers to achieve positive profits. Although the Mafia head could in principle dictate the pricing/service policies of its members, we regard this as an unrealistically centralized model of the organization. A loose coalition which only controls entry is consistent with the available evidence on actual coalitions.[16] Moreover, as shown below, a loose coalition is compatible with the observed structure and persistence of the Mafia. Indeed, although detailed price directives could potentially lead to higher profits, they would also offer more opportunities to cheat.

Formally, the Mafia head optimizes joint profits (equal to individual profits of the members) over n. We take total profit to be the relevant objective function because, as explained below, in the formation of the coalition, some of the original number of enforcers must be retired and compensated with a share of the profits.[17] The Mafia may be able to freely optimize n, or it may face the need to increase n sufficiently to prevent entry by ensuring that potential entrants cannot cover their costs. We consider both cases, taking the unconstrained case here and examining the constrained case in Section 3. In selecting the optimal n, the Mafia head

[16] In the Sicilian case, Mafia families within each province formed a coalition in the late 50s. The function of the coalition was to settle disputes within and between families, to chose family heads whenever a power vacuum occurred and, most importantly, to regulate mergers, divisions and allocation of territory.

[17] Later on in its history, the Mafia organization hires extra enforcers at competitive wages as distinguished from its members who have shares in total profits.

understands that each enforcer will choose to protect a share α^* of the properties in his area, where α^* is chosen so as to achieve (4).

Considering the selection of optimal n as part of the profit maximization problem we have:

$$\max_n \alpha^* \left(\frac{1}{1+\theta\frac{B\lambda}{nR}} - \frac{1}{1+\theta\frac{B(1-\lambda)}{1-\alpha^*}} \right) V^* - fn.$$

The optimal selection of n is assumed to take λ and B as given; the monopolist plays Nash with respect to the number of predators. The first order condition for n is:

$$\alpha^* V^* \pi(1-\pi)\frac{1}{n} - f = 0. \tag{8}$$

The first order condition is necessary and sufficient for an optimum since the objective function is concave in n.

The equilibrium system for determining all endogenous variables with a Mafia enforcement organization is formed by replacing the zero profit condition of monopolistic competition (5) with the first order condition in n. Then:

Proposition 2 *For $V(0)/f$ sufficiently large and $V(1)/f$ sufficiently small, and $w < \frac{\theta V^L}{(1-\alpha^*)}$, a unique interior monopoly solution exists.*

Proof: see the Appendix.

Monopoly restricts the level of enforcement, as is intuitive. Formally:

Proposition 3 *The optimal n chosen by the coalition, n^m , is lower than the one that would result under monopolistic competition.*

Proof (Sketch): To compare the equilibria we solve the sub-system which constrains both forms of organization for given n :

$$\begin{aligned}
\pi^* &= \frac{1}{1+\theta B\frac{\lambda/n}{R}} \\
\beta^* &= \frac{1}{1+\theta B\frac{1-\lambda}{1-\alpha}} \\
[1-\beta]\, V^L &= [1-\pi]\, V^H \\
B &= \frac{(1-\beta)\, V^L}{w}.
\end{aligned}$$

This yields $\pi^*(n), \beta^*(n), \lambda^*(n), B^*(n)$. The Appendix shows that profits are monotonically decreasing in n. This implies that the equilibrium number of enforcers must be smaller under the Mafia than under monopolistic competition. QED.

Security of property suffers from the organization of the coalition as follows. All else equal, if the enforcers form a coalition property will be less secure; the price of enforcement will be higher; there will be more predators; and the share of predators that choose to attack protected property will be higher.[18]

These results (profits to the Mafia coexisting with more predators and a lower share of unprotected property) all resemble the popular intuition that the Mafia acts as an extorter rather than an enforcer. Despite its clean hands, the Mafia looks guilty. Section 4 shows that starting from a nonextortionate equilibrium, the Mafia does always have an incentive to increase its profits by extortion, paying predators to prey on unprotected property. It may be restrained from doing so by social status or legal restrictions (interpreting the Mafia as a legal private enforcement agency).

The comparative statics of the model are similar to those reported in section 1.3 above.[19] The profits of the coalition are equal to:

$$P^* = V^* \alpha^* (1 - \beta^*) \left(\frac{\left(V^H - V^L\right)^2 - \beta^* \left(V^L\right)^2}{\left(V^H\right)^2} \right)$$

which is decreasing in β^*. It follows that profits are higher when the market for enforcement is tighter, either because of high demand (high θ, low w) or because of low supply (high f, low R). It is also interesting to note that profits per member $\left(\frac{P^*}{n^*} = \left(\frac{f\left(V^H - V^L\right)V^H}{(V^H - V^L + \beta^* V^L)V^L} \right) - f \right)$ are decreasing in w and R and increasing in θ. These comparative statics provide a channel through which development can shift the organization of enforcement. We

[18] That is, $\frac{\partial \pi^*(n)}{\partial n} > 0$, $\frac{\partial \beta^*(n)}{\partial n} > 0$, $\frac{\partial (\pi^*(n) - \beta^*(n))}{\partial n} < 0$, $\frac{\partial B^*(n)}{\partial n} < 0$, $\frac{\partial \lambda^*(n)}{\partial n} > 0$. Offsetting this disadvantage of monopoly, if uncoordinated enforcers have higher costs of obtaining a reputation R, the Mafia equilibrium can be more secure than the competitive equilibirum.

[19] The comparative statics on the number of enforcers are slightly more complex. If $V^H > 2V^L$ (i.e. the V function is steep) n moves in the opposite direction of π thus all the comparative statics are like those in Table 1. On the other hand if $V^H < 2V^L$ and π is very small, there might be a region in which n moves in the same direction as π so that results are reversed. Note that $V^H > 2V^L$ guarantees positive profits.

discuss these forces after incorporating the cost of organizing the coalition, as a richer story then emerges.

4 Coalition Formation and Stability

Coalitions frequently form peacably, and we focus on these.[20] To form a coalition the enforcers must sustain some coordination cost, which is increasing in n. A necessary condition for a mutually agreed coalition is that everybody, i.e. including those that either exit the market or become employees of other enforcers, is better off. The necessary condition for coalition formation is that the total coalition profits ("potential" benefit) exceed the coordination cost *evaluated at the number of enforcers under competitive equilibrium.* A similar rationale applies to the coalition in its maturity. As we show below, the Mafia forestalls breakup from competitive entry by maintaining a fringe of hangers-on at some wage. This constitutes an excess capacity (up to the competitive level of enforcement) which deters entry, as we show below. That powerful Sicilian families let smaller families operate in their territory under their direct supervision (Gambetta 1994) supports our assumption about the structure of the coordination cost.

4.1 Coalition Formation

Assume that the coordination cost is linear in the number of original members, the monopolistic competition solution n^c . The net profits from forming the coalition are $\Phi(X) = P^*(X) - cn^c$, where P^* is the optimized profit of the coalition, c is the per capita cost of coordination and $X = R, w, \theta$. The coalition can form only if $\Phi > 0$. This necessary condition is also sufficient with rational enforcers provided the coordination cost reflects all costs.

Key insight into when coalitions form is gained from the comparative statics of coalition net profits. The comparative statics are not a trivial extension of previous results because X affects P^* and n^c in a similar way. For instance, a fall in w increases coalition profits while at the same time it increases the number of enforcers and hence the coordination costs. Further restrictions produce sharp results.

[20] Conflict can of course result in coalitions which destroy opposing rivals. This may be associated with errors or asymmetries in a rational maximizing environment.

Lemma 4 *If $V(\alpha)$ is linear then profits are increasing in w when w is small and decreasing when w is large.*
Proof: *see the Appendix.*

If we assume that economic development improves the bandits' income in alternative occupations,[21] the Lemma implies that *Mafias are likely to emerge at intermediate stages of development.* If w were very high there would be no bandits and no scope for enforcement (since there is no interior solution when w is high). If w were very low there would be many bandits and many enforcers in monopolistic competition. The latter would make the transition to the coalition structure difficult because of coordination costs. Figure 1 in the Appendix simulates our model.[22] Similarly, if R is high at the start there will be only a few enforcers in monopolistic competition, which implies that they can coordinate and move to a coalition very easily (see Figure 2 in the Appendix). Interestingly, this is consistent with the fact that the founders of most Mafias were people with an existing reputation for strength/brutality like the Sicilian feudal guards and the Japanese samurai. It is also consistent with the fact that Mafias emerged only in some of the cases in which the rule of law was missing. We could argue that in the other cases, private enforcers did exist when the state was weak but didn't manage to collude and thus survive the conditions that determined their rise in the first place.

4.2 Why the Coalition Is Stable

Coalitions in general are difficult to enforce in the absence of legal mechanisms to restrain opportunistic behavior. The incentives to defect rise with the profits of the coalition. The success of Mafia coalitions thus presents something of a puzzle: stable, long- lived and profitable coalitions persist despite a complete absence of legal enforceability.

Members' incentive to defect and outside enforcers' incentive to enter the market crucially depend on the comparison between the enforcement

[21]It could be argued that development might increase the value of property as well as the bandits' outside option. Allowing for this additional effect complicates the analysis but leaves the results substantially unchanged if the increase in w is sufficiently larger than the increase in v.

[22]For the simulation we assume that $f = \frac{\alpha V}{15}; R = 2$ (when fixed); $w = \frac{1}{32}$ (=1/4 expected value of unprotected property, when fixed) and $f/d = 1$

technology of the Mafia and that of individual enforcers. The organization plausibly has a better technology, reflected in a smaller expenditure f for given reputation R than do independent enforcers.[23]

Note that, since the coalition does not dictate the price/service policies of its members, the latter cannot cheat in the "classical" sense. Competitive entry is therefore the main threat to the coalition's survival. The power of the Mafia to maintain its coalition against competitive outsiders depends on the excess capacity it has retired in order to form in the first place. Let f^e be the fixed cost entrants have to pay to acquire reputation R. Define gross revenues $G(n) = [\pi - \beta] V(\alpha)$; $G_n < 0$,as shown in the Appendix. Profits for the coalition are equal to $G(n^m) - fn^m - cn^c > 0$.

Proposition 5 *For $f^e \geq f + cn^c/n^m$, the coalition is stable. For $f < f^e < f + cn^c/n^m$, the coalition is knife-edge stable.*

Proof:
1. if the fixed cost of entrants is high enough, $f^e > \frac{1}{n^m} G(n^m)$, then no one will find it profitable to enter.
2. If $f^e > f$ but still not too high $\left(f + c\frac{n^c}{n^m} < f^e < \frac{1}{n^m} G(n^m)\right)$ somebody will enter but there will not be enough pressure to make the coalition split (i.e. coalition profits are still positive, despite entry). The coalition's best response in this case is to increase n^m and drive the entrants out of the market. Indeed, following entry, the coalition's profits would be: $\frac{n^m}{n^m+n^e} G(n^m + n^e) - fn^m - cn^c = (f^e - f) n^m - cn^c$. Whereas if the coalition increases its membership up to $(n^m + n^e)$ its profits would be $G(n^m + n^e) - f(n^m + n^e) - cn^c = (f^e - f)(n^m + n^e) - cn^c$, which is larger than $(f^e - f) n^m - cn^c$. It is then credible for the coalition to say that in case of entry it will raise n_m slightly above $(n_m + n_e)$, generating negative profits for the entrants.
3. If $f < f^e < f + cn^c/n^m$, then there will be no *successful* attacks.

[23]This is so for two reasons. First, reputation requires investment by the enforcer to acquire and maintain. An individual enforcer acting alone has limited ability to impress the surrounding population with his efficiency and brutality whereas coalition members can benefit from other members' reputation and are thus able to achieve a given level of reputation at lower cost than it would take to acquire it on their own. Second, the organization can share information and apprehension of the predators who attempt to run away into other 'jurisdictions', much as local law enforcement agencies cooperate in legal enforcement activity. This increases the capability of the individual enforcers.

If entrants face the same fixed cost f as the Mafia, they will enter until $\frac{n^e}{n^m+n^e}G\left(n^m+n^e\right)-fn^e=0$, which implies that $n^e=n^c-n^m$. If n^e new enforcers enter the market the coalition profits will equal: $\frac{n^m}{n^m+n^e}G\left(n^m+n^e\right)-cn^c=-cn^c<0$. Clearly, this cannot be an equilibrium and the coalition will break down. Now there are too many enforcers in the market, all making negative profits so that some enforcers must exit. It is reasonable to think that the new entrants will be pushed out for they are less well known as enforcers. In this case the coalition is knife-edge stable, i.e. there is an equilibrium in which the coalition makes positive profits and is never attacked, QED.

The stability result should be qualified on two lines. On the one hand, note that in the knife edge case, an asymmetry which favors entrants will tip the balance to successful entry. Moreover, case 2 must be qualified when the fixed cost advantage of the Mafia is offset by a coordination cost $C(n^m)$ which is plausibly increasing and strictly convex in the number of Mafia members n^m. Previously we have set $C'=f$ and $C''=0$. Obviously, as C'' is large, the Mafia finds it costly to drive n^m large enough to displace all competitive firms, so the equilibrium includes a competitive fringe. On the other hand, the comparative statics of the Mafia coalition show that as the Mafia's experience and reputation grows (R rises), then the optimal n^m falls. This lowers the coordination cost and makes the Mafia still more impervious to outside competition. This is an important aspect of the apparent stability of Mafias over time.

5 The Mafia as Predator

Our treatment of the Mafia analyzes its socially productive role as a provider of enforcement services. The Mafia is often alternatively portrayed as an extorter, offering 'enforcement' from harm it will inflict unless payment is made. As explained above, we focus on the role of the Mafia as an enforcer of lawful rights because this guaranteed legitimacy and promoted the rise of the Mafia in the first place. Once established, however, the Mafia had enough power to also act as an extorter. A simple extension of our model formalizes a synthesis of the two views. The Mafia coalition of the preceding sections can increase its profits by engaging in some predation on unprotected property, thereby raising demand for its enforcement. The predators under Mafia license must be paid their opportunity cost, equal to the expected gain from predation on unprotected property plus an extra payment from the Mafia. We assume the Mafia optimally selects the amount of extra predation.

Predators allocate themselves between protected and unprotected property to equalize the return, which is equal to the opportunity cost of the marginal predator. The opportunity costs x are assumed to be uniformly distributed on the interval $[0, w]$. This leads to the expression for independent predators supply:

$$B = \Pr[x \leq (1-\beta)V^L] = \frac{(1-\beta)V^L}{w}$$

Now assume that the Mafia wishes to raise the level of predation above that level. It can hire predators and assure them a payment equal to their opportunity cost. This leads to a supply of Mafia licensed predators equal to:

$$B^m = \Pr[(1-\beta)V^L \leq x \leq (1-\beta)V^L + m] = \frac{m}{w}$$

The total supply of predators is equal to $B + B^m$. By controlling its payment m, the Mafia controls the supply of predators at the margin. The licensed predators will prey only on unprotected property, but the equilibrium allocation condition of unlicensed predators continues to determine the fraction of all predators who attack protected property by equality of returns between attacks on protected and unprotected property.

The Mafia coalition controls the number of enforcers n and the payment to licensed predators m. We assume away potential entry for simplicity. The efficient Mafia solves:

$$\max_{n,m} V^*\alpha^* \left[\frac{1}{1+\theta(B+m/w)\frac{\lambda}{nR}} - \frac{1}{1+\theta(B+m/w)\frac{1-\lambda}{1-\alpha^*}} \right] - fn - m^2/w.$$

The first order condition with respect to m is

$$V^*\alpha^* \frac{\theta}{w} \left[-\pi \frac{\lambda}{nR} + \beta \frac{1-\lambda}{1-\alpha^*} \right] - 2\frac{m}{w} = 0. \tag{9}$$

It can be shown that the square bracket term is always positive when $\pi > \beta$, as required for equilibrium. This implies that it always pays for the Mafia to enlist at least some licensed predators to raise demand for its services. The optimal interior values of m and n are implied by the first order conditions, provided the second order conditions are met. The objective function is not necessarily concave in m, especially for arbitrary values of λ. Therefore it is possible that the best solution for the Mafia is to enlist all available predators. We ignore this possibility in our discussion. The main point is that the Mafia will always have an incentive to prey on the unprotected, 'subsidizing' attacks on unprotected property.

How important is the Mafia's incentive to prey on the unprotected? If small,we may expect that cultural norms prevent the Mafia from predatory behavior. If the incentives are large, we may expect that norms fail and avarice prevails. If the Mafia is interpreted as a legitimate private protection agency, then legal restrictions prevent extortion.

6 Optimal vs. Private Enforcement

States are often represented as maximizing a social welfare function with their policies, justified by thinking of redistributive policies. Welfare maximizing policy on *legal* property rights enforcement is thus interesting to compare with private Mafia or competitive enforcement whether or not we believe any states closely approach this behavior. Intuitively we expect that welfare-maximizing state policy will protect more property with a greater intensity of force than will a monopoly enforcer when all else is equal. In contrast, our model implies that (1) the welfare-maximizing state will always defend any given proportion of property less intensively than would Mafia or competitive enforcement and (2) the state could choose to defend a lower proportion of property. These at first puzzling results arise because of the negative externality which enforcement inflicts on the undefended property — the welfarist state cares about the deflection of predation onto low value property whereas the private enforcers do not. We give an example of optimal underenforcement by the state below.

In circumstances where the welfare-maximizing state defends a lower proportion of property less intensively, *even a strong state may not be able to maintain its policy against private enforcement.* All its potential customers for enforcement would prefer the private organization of enforcement. Private enforcement in either its competitive or Mafia version may then come along and *cream skim* the most valuable property. As an example of this phenomenon, think of the growth of gated communities containing people who shelter their incomes in offshore tax havens. The deflected predators batten onto the low value state protected or unprotected property with greater intensity, increasing the incentive to defect from state enforcement.

The cream skimming problem in enforcement is more general than our setup might indicate. For example, the 'political support function' approach models the state as maximizing a combination of contributions from its supporters (in our model, the rich) and the general welfare (reflecting the interests of the poor voters). The political support maximizing state cares more about the poor than does the Mafia and may face cream skimming.

The welfarist state has several options when facing cream skimming. At one extreme, when it is weak, it can forestall the privatization of enforcement by abandoning its welfare-maximizing policy and imitating the Mafia. This solution resembles state enforcement policy being "captured" by the rich. But since Mafia enforcement potentially has advantages over an imitative state, even imitating the Mafia may not suffice to eliminate it. For instance, Mafias or other private enforcers may be able to ignore civil rights and other restrictions on legal enforcement processes. Moreover, Grossman (1995) argues that a coexistence in Nash equilibrium will provide more enforcement than the state would choose if it were a monopoly which maximized rents. Applying his insight here, state imitation may do worse for the poor than leaving enforcement to the Mafia. At the other extreme, a sufficiently strong state can regulate or eliminate private enforcement to enact its own welfare-maximizing policy. There are likely to be economies of scale in enforcement provision which enhance the power of the state. More democratic states are more likely to place weight on the welfare of the owners of lower value property. These considerations suggest that a strong democratic state may drive out private enforcement. It is premature to build a model of state rivalry with the Mafia, but the considerations we present will be part of such a full political economy model.

For simplicity, suppose that the state and the private sector have the same enforcement technology and that the state can collect lump sum taxes to pay for the cost of enforcement. The welfare function of the state is the expected value of property less the cost of defense: $W(n, \alpha; B, \lambda) \equiv \pi(n, B, \lambda)S(\alpha) + \beta(\alpha, B, \lambda)D(\alpha) - fn$ where $S(\alpha) \equiv \int_0^{\alpha} V(x)dx - \alpha V(\alpha)$, $D(\alpha) \equiv \int_0^1 V(x)dx - V(1) - S(\alpha)$. $S(\alpha)$ and $D(\alpha)$ are the surpluses associated with protected and unprotected property respectively. The objective probability functions $\pi(\cdot)$ and $\beta(\cdot)$ are the same as in our earlier analysis.

We assume that the state plays Nash against the predators so λ and B are taken as given. Welfare changes with α and n according to:

$$\begin{aligned} W_\alpha &= (\pi - \beta)(-\alpha V_\alpha) + D\beta_\alpha \\ W_n &= \pi_n S - f. \end{aligned} \tag{10}$$

These should be compared to the first order conditions for the Mafia:

$$\begin{aligned} (\pi - \beta)(V + \alpha V_\alpha) &= 0 \\ \pi_n \alpha V(\alpha) - f &= 0. \end{aligned} \tag{11}$$

To compare the Mafia and welfarist solutions, we consider evaluation of the welfare derivatives (10) at the Mafia solution values and see in which direction α and n must move to approach the social welfare maximizing values. $W_n(n^m, \alpha^m) < 0$ whenever $S(\alpha^m) < \alpha^m V(\alpha^m)$, which holds in a wide class of cases. (For example, with linear demand for the valuation of property, we can show that W_n is negative.[24]) Then the state employs fewer enforcers, since $\pi_{nn} < 0$ at the Mafia solution (by the Mafia's second order condition). The intuition is that the rich who buy enforcement overvalue it from a social point of view at the margin: $\pi_n S < \pi_n \alpha V$. Nevertheless, the rich who obtain enforcement prefer the Mafia because a typical rich individual i with valuation $V(\alpha^i)$ earns a surplus from dealing with the Mafia equal to $(\pi - \beta)[V(\alpha^i) - V(\alpha^m)]$, a surplus which *is* locally increasing in n. A rise in n also indirectly benefits the poor, since in general equilibrium a sufficient number of predators are driven out so that β also rises. We assume the state plays Nash against the predators so the state does not internalize this externality. In contrast to the clear results for n, $W_\alpha(n^m, \alpha^m) \gtreqless 0$. This arises because of the tradeoff of two forces, the monopoly power of the Mafia (which limits sales) vs. the negative externality enforcement inflicts on unprotected property (which limits state enforcement). With no externality, $\beta_\alpha = 0$ and the state would protect all property, from (10), whereas the monopoly power of the Mafia limits sales, from (11). Thus the

[24]For the linear V case, $S = -\alpha^2 V_\alpha / 2$. At the profit maximizing value of α^m, $S = \alpha V/2$. Then

$$\begin{aligned} W_n(n^m, \alpha^m) &= \pi_n(n^m, \alpha^m)\alpha^m V(\alpha^m)/2 - f \\ &= -\pi_n \alpha V/2 < 0, \end{aligned}$$

where the second equation follows from using the Mafia's first order condition.

fraction of property the state chooses to protect might be higher or lower than that protected by the Mafia, depending on the value of the exogenous parameters. [25]

The Appendix shows that for linear V, the state protects less property than the Mafia whenever the equilibrium β^m is sufficiently large. Exact expressions for the critical value are derived. It is interesting to note that the state will locally protect less properties when the outside opportunity cost of predation (w) is high.[26] Associating w with economic development, we infer that cream skimming is more likely for more developed economies.[27]

7 Conclusion

We have built a formal general equilibrium model of the Mafia as a coalition of enforcers of property rights. The model identifies the conditions under which Mafia coalitions are likely to form and persist. Genuine enforcement and extortion are complementary activities in the model; therefore the Mafia is likely to engage in both at the same time. Compared to competitive enforcement, the Mafia offers too little enforcement at too high a price. Compared to socially optimal enforcement, however, the Mafia offers too much enforcement because private enforcement ignores the effect of increased predation on the unprotected property. This, in turn, explains why Mafias can persist in the presence of a strong state.

The elements of this paper provide a framework for future work. First, they indicate the payoff to a study of the industrial organization of the Mafia. What legal enforcement does it concede to the state and under what circumstances? If, as in recent years, its main business is the protection

[25] Moreover, the local concavity of W in α cannot be inferred from the local concavity of the Mafia′s profit function at $n^m, \alpha^m,$ .which means we cannot infer the welfare improving direction of change in α from the first derivative only.

[26] Whether the state protects less properties than the Mafia depends on the equilibrium value of β (the probability of successful self-defence) being sufficiently high and β is increasing in w as shown above.

[27] What about competitive private enforcement compared to the social optimum? The Mafia and competive enforcers both protect the same proportion of property, while competitive enforcement offers more enforcers than does the Mafia coalition, which in turn offers more than the optimal amount. Thus competition does worse than the Mafia in n while offering the same value of α.

of illegal trade, why does it refrain from monopolizing the production of illegal goods? We hope to explore these themes in future research.

A key simplification of this paper is that the amount of property to be protected or predated is constant. Most forms of enforcement are likely to increase the volume of the protected activity. This can be desirable if the activity is good but undesirable if the activity is bad. In a sequel paper we analyze the enforcement of exchange.

8 Appendix

8.1 Solution and Comparative Statics- Monopolistic Competition

8.1.1 Solution

The system is:

$$\begin{aligned}
\pi^* &= \frac{1}{1+\theta B \frac{\lambda/n}{R}} \\
\beta^* &= \frac{1}{1+\theta B \frac{1-\lambda}{1-\alpha}} \\
[1-\beta]\, V^L &= [1-\pi]\, V^H \\
\pi - \beta &= \frac{nf}{V^* \alpha^*} \\
B &= \frac{(1-\beta)\, V^L}{w}
\end{aligned}$$

The solution:

$$\begin{aligned}
\pi^* &= \frac{V^L}{V^H}\beta^* + \frac{V^H - V^L}{V^H} \\
\lambda^* &= 1 - \frac{w\,(1-\alpha^*)}{\theta V^L \beta^*}. \\
B^* &= (1-\beta^*)\,\frac{V^L}{w} \qquad (12) \\
n^* &= V^* \alpha^* \frac{\left(V^H - V^L\right)(1-\beta^*)}{f V^H} \qquad (13)
\end{aligned}$$

Where β^* is a root of

$$\left(fV^H\left(V^L\right)^2\theta+RV^*\alpha^*wV^L\left(V^H-V^L\right)\right)\beta^2+$$
$$\left(+fV^HV^L\theta\left(V^H-V^L\right)-fV^HV^Lw\left(1-\alpha\right)-RV^*\alpha^*wV^L\left(V^H-V^L\right)\right)\beta+$$
$$-fV^Hw\left(1-\alpha\right)\left(V^H-V^L\right)=0$$

Define $a=\left(fV^H\left(V^L\right)^2\theta+RV^*\alpha^*wV^L\left(V^H-V^L\right)\right)$
$b=\left(+fV^HV^L\theta\left(V^H-V^L\right)-fV^HV^Lw\left(1-\alpha\right)-RV^*\alpha^*wV^L\left(V^H-V^L\right)\right)$
$c=-fV^Hw\left(1-\alpha\right)\left(V^H-V^L\right)$

The polynomial has two roots: $\rho_1=\frac{-b-\sqrt[2]{b^2-4ac}}{2a}$ and $\rho_2=\frac{-b+\sqrt[2]{b^2-4ac}}{2a}$

8.1.2 Existence and Uniqueness

An interior solution exist if $\rho_{1,}\rho_2$ are real and if at least one of them is between 0 and 1.

1. $\left(V^H-V^L\right)>0\Rightarrow c<0\Rightarrow b^2-4ac>0\rightarrow\rho_{1,}\rho_2$ are real

2. We show that the smallest root of the quadratic expression above is always negative, thus if a solution exists it is unique:
$\frac{-b-\sqrt[2]{b^2-4ac}}{2a}<0$ if $-b<\sqrt[2]{b^2-4ac}$
If $b>0$ this is always true.
If $b<0: 4ac<0\Rightarrow b^2<b^2-4ac$ always.

3. An interior solution exists if the largest root lies between 0 and 1 :
$\frac{-b+\sqrt[2]{b^2-4ac}}{2a}>0$ if $\sqrt[2]{b^2-4ac}>b$
If $b<0$ it is always true
If $b>0$ then $4ac<0\rightarrow\ b^2-4ac>b^2$ always.

$\frac{-b+\sqrt[2]{b^2-4ac}}{2a}<1$ if $\sqrt[2]{b^2-4ac}<b+2a$
Taking squares and rearranging we get: $a+b+c>0$,which is satisfied iff $w<\frac{\theta V^L}{(1-\alpha^*)}$[28]

Thus $\beta^*=\frac{-b+\sqrt[2]{b^2-4ac}}{2a}$

[28] $w<\frac{\theta\bar{V}^L}{(1-\alpha^*)}$ is also sufficient to guarantee that $b+2a>0$

8.1.3 Comparative Statics

Note that:
$\frac{\partial\beta}{\partial X} = \frac{-\left(\frac{\partial a}{\partial X}\beta^2+\frac{\partial b}{\partial X}\beta+\frac{\partial c}{\partial X}\right)}{2a\beta+b}$ where $X = R, w, \theta, f$

Note also that $2a\beta + b = \sqrt[2]{b^2 - 4ac} > 0$
By straightforward (and tedious) computation we can show that:

$\frac{\partial\beta}{\partial R} = \frac{\beta(1-\beta)V^*\alpha^* wV^L\left(V^H-V^L\right)}{2a\beta+b} > 0;$
$\frac{\partial\beta}{\partial w} = \frac{\beta(1-\beta)V^*\alpha^* RV^L\left(V^H-V^L\right)+\beta fV^HV^L(1-\alpha)+fV^H(1-\alpha)\left(V^H-V^L\right)}{2a\beta+b} > 0$
$\frac{\partial\beta}{\partial\theta} = \frac{-\left(\beta^2 fV^H\left(V^L\right)^2+\beta fV^HV^L\left(V^H-V^L\right)\right)}{2a\beta+b} < 0$
$\frac{\partial\beta}{\partial f} = -\frac{1}{f}\frac{\beta(1-\beta)V^*\alpha^* RV^L\left(V^H-V^L\right)}{2a\beta+b} < 0$

which implies that:
$\frac{\partial\pi}{\partial R} = \frac{V^L}{V^H}\frac{\partial\beta}{\partial R} > 0;$ $\frac{\partial\pi}{\partial w} = \frac{V^L}{V^H}\frac{\partial\beta}{\partial w} > 0;$ $\frac{\partial\pi}{\partial\theta} = \frac{V^L}{V^H}\frac{\partial\beta}{\partial\theta} < 0;$ $\frac{\partial\pi}{\partial f} = \frac{V^L}{V^H}\frac{\partial\beta}{\partial f} < 0;$

and:
$\frac{\partial B}{\partial R} = -\frac{V^L}{w}\frac{\partial\beta}{\partial R} < 0;$ $\frac{\partial B}{\partial\theta} = -\frac{V^L}{w}\frac{\partial\beta}{\partial\theta} > 0;$ $\frac{\partial B}{\partial f} = -\frac{V^L}{w}\frac{\partial\beta}{\partial f} > 0;$ $\frac{\partial B}{\partial w} = -\frac{V^L}{w}\frac{\partial\beta}{\partial w} - (1-\beta^*)\frac{V^L}{w^2} < 0;$
and:
$\frac{\partial\lambda}{\partial R} = \frac{w(1-\alpha^*)}{\theta V^L\beta^2}\frac{\partial\beta}{\partial R} > 0;$ $\frac{\partial\lambda}{\partial f} = \frac{w(1-\alpha^*)}{\theta V^L\beta^2}\frac{\partial\beta}{\partial f} < 0$

and finally that:
$\frac{\partial n}{\partial R} = -\frac{V^*\alpha^*\left(V^H-V^L\right)}{fV^H}\frac{\partial\beta}{\partial R} < 0;$ $\frac{\partial n}{\partial\theta} = -\frac{V^*\alpha^*\left(V^H-V^L\right)}{fV^H}\frac{\partial\beta}{\partial\theta} > 0;$
$\frac{\partial n}{\partial w} = -\frac{V^*\alpha^*\left(V^H-V^L\right)}{fV^H}\frac{\partial\beta}{\partial w} > 0.$

8.2 Solution and Comparative Statics- Coalition Case.

The system is:

$$\begin{aligned}
\pi^* &= \frac{1}{1+\theta B\frac{\lambda/n}{R}} \\
\beta^* &= \frac{1}{1+\theta B\frac{1-\lambda}{1-\alpha}} \\
[1-\beta]\,V^L &= [1-\pi]\,V^H
\end{aligned}$$

$$
\begin{aligned}
n &= \frac{\alpha^* V^* \pi (1-\pi)}{f} \\
B &= \frac{(1-\beta) V^L}{w}
\end{aligned}
$$

The solution is:

$$
\begin{aligned}
\pi^* &= \frac{V^L}{V^H}\beta^* + \frac{V^H - V^L}{V^H} \\
\lambda^* &= RV^*\alpha^* w V^L \frac{(1-\beta^*)}{\theta f \left(V^H\right)^2} \\
B^* &= \frac{(1-\beta^*)V^L}{w} \qquad (14) \\
n^* &= \frac{V^*\alpha^*}{f}\pi^*\left(1-\pi^*\right) \qquad (15)
\end{aligned}
$$

Where β^* is a root of $\left(RV^*\alpha^* w (V^L)^2\right)\beta^2 + \left(f\theta V^L \left(V^H\right)^2 - RV^*\alpha^* w (V^L)^2\right)\beta - f\left(V^H\right)^2 w\left(1-\alpha\right) = 0$

Define

$A = \left(RV^*\alpha^* w (V^L)^2\right)$

$B = \left(f\theta V^L \left(V^H\right)^2 - RV^*\alpha^* w (V^L)^2\right)$

$C = -f\left(V^H\right)^2 w\left(1-\alpha\right)$

8.2.1 Existence and Uniqueness

An interior solution exist if q_1,q_2 are real and if at least one of them is between 0 and 1.

$\alpha < 1 \rightarrow C < 0 \Rightarrow B^2 - 4AC > 0 \rightarrow q_1$,$q_2$ real

2. We show that the largest root of the quadratic expression above is never larger than 0, thus if a solution exists it is unique:

$\frac{-B-\sqrt[2]{B^2-4AC}}{2A} > 0$ if $\sqrt[2]{B^2-4AC} < -B$.

If $B > 0$ then $-B < 0 \rightarrow \sqrt[2]{B^2-4AC} > -B$ always.

If $B < 0$ then $4AC < 0 \rightarrow \sqrt[2]{B^2-4AC} > -B$ always.

3. An interior solution exists if the largest root lies between 0 and 1 :

$\frac{-B+\sqrt[2]{B^2-4ac}}{2a} > 0$ if $\sqrt[2]{B^2-4AC} > B$

If $B < 0$ it is always true

If $B > 0$ then $4AC < 0 \rightarrow \sqrt[2]{B^2-4AC} > B$ always.

$\frac{-B+\sqrt[2]{B^2-4AC}}{2A} < 1$ if $\sqrt[2]{B^2-4AC} < B+2A$

It is immediate to show that $2A+B > 0$.Taking squares and rearranging the above condition can be written as $A+B+C > 0$,which is satisfied iff $w < \frac{\theta V^L}{(1-\alpha^*)}$

Thus $\beta^* = \frac{-B+\sqrt[2]{B^2-4AC}}{2A}$

8.2.2 Comparative Statics.

Note that:

$\frac{\partial q}{\partial X} = \frac{-\left(\frac{\partial A}{\partial X}\beta^2+\frac{\partial B}{\partial X}\beta+\frac{\partial C}{\partial X}\right)}{2A\beta+B}$ where $X = R, w, \theta, f$

Note also that $2A\beta + B = \sqrt[2]{B^2-4AC} > 0$

By straightforward (and tedious) computation we can show that:

$\frac{\partial \beta}{\partial R} = \frac{\beta(1-\beta)V^*\alpha^* w(V^L)^2}{2A\beta+B} > 0;$

$\frac{\partial \beta}{\partial w} = \frac{\beta(1-\beta)V^*\alpha^* R(V^L)^2+f\left(V^H\right)^2(1-\alpha)}{2A\beta+B} > 0;$

$\frac{\partial \beta}{\partial \theta} = \frac{fvV^L\left(V^H\right)^2}{2A\beta+B} > 0;$

$\frac{\partial \beta}{\partial f} = \frac{-\left(V^H\right)^2\left(\beta\theta V^L-w(1-\alpha)\right)}{2A\beta+B} < 0$ since $\left(\beta\theta V^L - w\left(1-\alpha\right)\right) > 0$[29]

and:

$\frac{\partial \pi}{\partial R} = \frac{V^L}{V^H}\frac{\partial \beta}{\partial R} > 0; \frac{\partial \pi}{\partial w} = \frac{V^L}{V^H}\frac{\partial \beta}{\partial w} > 0; \frac{\partial \pi}{\partial \theta} = \frac{V^L}{V^H}\frac{\partial \beta}{\partial \theta} < 0; \frac{\partial \pi}{\partial f} = \frac{V^L}{V^H}\frac{\partial \beta}{\partial f} < 0$

and:

$\frac{\partial B}{\partial R} = -\frac{V^L}{w}\frac{\partial \beta}{\partial R} < 0; \frac{\partial B}{\partial \theta} = -\frac{V^L}{w}\frac{\partial \beta}{\partial \theta} > 0; \frac{\partial B}{\partial f} = -\frac{V^L}{w}\frac{\partial \beta}{\partial f} > 0; \frac{\partial B}{\partial w} = -\frac{V^L}{w}\frac{\partial \beta}{\partial w} - \left(1-\beta^*\right)\frac{V^L}{w^2} < 0;$

finally:

$\frac{\partial n}{\partial X} = \frac{V^*\alpha^*}{f}\left(1-2\pi\right)\frac{\partial \pi}{\partial X}$ for $X = R, w, \theta$.

If $\pi > \frac{1}{2}$[30] we have:

$\frac{\partial n}{\partial R} < 0; \frac{\partial n}{\partial w} < 0; \frac{\partial n}{\partial \theta} > 0.$

[29] $\left(\beta\theta vV^L - w\left(1-\alpha\right)\right) > 0$ if $\beta > \frac{w(1-\alpha)}{\theta vV^L} = \frac{-C}{A+B}$ which is verified.

[30] A sufficient condition is $V^H > 2V^L$, which also guarantees that profits are positive.

8.3 Coalition vs Monopolistic Competition: a Comparison

This section compares the outcomes in the cases of monopolistic competition and coalition. Since the two cases differ only for the equation that determines n, instead of comparing parameter values directly we solve the system as a function of n and analyze how parameters change with n.

$$\begin{aligned}
\pi &= \frac{1}{1+\theta B\frac{\lambda/n}{R}} \\
\beta &= \frac{1}{1+\theta B\frac{1-\lambda}{1-\alpha}} \\
[1-\beta]\,V^L &= [1-\pi]\,V^H \\
B &= \frac{(1-\beta)\,V^L}{w}
\end{aligned}$$

the interior solution is:

$\beta^* = \frac{w(1-\alpha)}{\theta V^L(1-\lambda^*)}$; $\pi^* = \frac{V^L}{V^H}\beta^* + \frac{V^H-V^L}{V^H}$; $B = \frac{V^L}{w} - \frac{(1-\alpha)}{\theta(1-\lambda^*)}$ and $\lambda^* = \frac{-b-\sqrt[2]{b^2-4ac}}{2a}$

where[31]:

$a = \theta\left(V^H - V^L\right)$

$b = -\left(\theta\left(V^H - V^L\right) + w\,(1-\alpha) + Rnw\right)$

$c = Rnw$

Profits are equal to: $P(n) = \frac{V^H-V^L}{V^H}\left(1-\beta^*(n)\right)V^*\alpha^* - fn.$

We can show that:

1. If a coalition is formed there will be fewer enforcers.

Note that $\frac{\partial\beta^*}{\partial\lambda^*} > 0$ and that $\frac{\partial\lambda^*}{\partial n} = \frac{Rw(1-\lambda^*)}{\sqrt[2]{b^2-4ac}} > 0$, from which it follows that $\frac{\partial P}{\partial n} < 0$.

Since profits are positive if there is a coalition and zero under monopolistic competition it follows that, given $\frac{\partial P}{\partial n} < 0$, there must be more enforcers in the monopolistically competitive case.

[31] It is easy to show that the other solution is always larger than 1.

2. If a coalition is formed every property will be less secure, there will be more bandits and the share of bandits attacking protected property will be higher.

Note that $\frac{\partial \beta^*}{\partial \lambda^*} > 0, \frac{\partial \pi^*}{\partial \lambda^*} > 0, \frac{\partial B^*}{\partial \lambda^*} < 0$. The result follows from $\frac{\partial \lambda^*}{\partial n} > 0$ and the fact that n is smaller when a coalition is formed.

8.4 Additional Results when V is linear.

For the linear V case we can obtain the welfare derivative with respect to α of Section 5 as

$$\begin{aligned} W_\alpha &= \frac{-V_a}{2}\left[2\alpha^m(\pi^m - \beta^m) - (1+\alpha^m)\beta^m(1-\beta^m)\right] \text{ where we use} \\ \beta_\alpha &= -\beta(1-\beta)/(1-\alpha). \end{aligned}$$

For $V(1) = 0$, $\alpha^m = 1/2$. Moreover, evaluating (6) for the linear case we obtain

$$\begin{aligned} (1-\pi)\left[1+\widehat{V}\right] &= (1-\beta)/2 \\ &\Longrightarrow \pi - \beta = (1-\beta)\frac{1+\widehat{V}}{2+\widehat{V}} \; \textit{where} \\ \widehat{V} &\equiv \frac{V(0)-V(1/2)}{2V(1/2)} > 0. \end{aligned}$$

Substituting into W_α we obtain:

$$W_\alpha = \frac{-V_a}{2}(1-\beta^m)\left[\frac{1+\widehat{V}}{2+\widehat{V}} - \frac{3}{2}\beta^m\right] < 0 \; \textit{for} \; \beta^m \geq 1/2.$$

Evaluating the second derivative we obtain:

$$\begin{aligned} W_{\alpha\alpha} &= \frac{-V_\alpha}{2}(1-\beta^m)\left\{\frac{1+\widehat{V}}{1+\widehat{V}/2} + \frac{\beta^m}{1-\alpha^m}\left[-1+3\alpha^m+(1+\alpha^m)(1-2\beta^m)\right]\right\} \\ &= \frac{-V_\alpha}{2}(1-\beta^m)\left\{\frac{1+\widehat{V}}{1+\widehat{V}/2} + 2\beta^m(2-3\beta^m)\right\} \; \textit{with} \; \alpha^m = 1/2. \end{aligned}$$

For β^m sufficiently large, W is decreasing in α and locally concave in α at α^m. Since $W_{\alpha n} = 0$, for β^m sufficiently large, W is locally concave in α, n. This suggests that the optimal values of α and n are smaller than for the Mafia when β^m is sufficiently large. Of course, since endogenous variables such as λ will change with α and n, W need not be a concave function of α and n. Thus it is difficult to compare the optimal values of α and n defined by $W_a = 0 = W_n$ with the Mafia solution α^m, n^m in general. We derive exact solutions for the critical value of β^m for which the state protects less property in the case where: $V = b - \frac{\alpha}{2}$ and $b = 0.5 \Rightarrow V^H = 3/8; V^L = 1/8$.

8.4.1 Welfare Maximizing State vs. the Mafia (appendix to section 6)

Note that $V(1) = 0 \Longrightarrow V_\alpha = -V(0) = -V^0$. For linearity we can show that $D > \alpha V > S$ for $\alpha < 1$. The profit maximizing Mafia solution for α is 1/2 in the linear case. Then $D = 3S$, $\alpha V = 2S, S = -V_\alpha/8 = V(0)/8$. Since $\pi_n = \pi(1-\pi)/n$, comparing the optimal and Mafia derivatives with respect to n at the profit maximizing $\alpha = 1/2$, we see that since $\alpha V > S$, the state must have too small a value of π_n for its first order condition to hold when evaluating at the Mafia solution. By $\pi_{nn} < 0$ the state must reduce n to move toward its optimum. Now evaluate the derivative of welfare with respect to α at the Mafia value of $\alpha = 1/2, n = n_m$. Using the formula for β, we have $\beta_\alpha = -\beta(1-\beta)/(1-\alpha)$. We know $D = (-V_\alpha/2)(1-\alpha^2)$ using linearity. The social welfare derivative with respect to α can now be written as

$$(\pi - \beta)(-\alpha V_\alpha) + D(\alpha)\beta_\alpha = (-V_\alpha)[(\pi - \beta)\alpha - \beta(1-\beta)(1+\alpha)/2].$$

Evaluating the square bracket expression at $\alpha = 1/2$ and factoring out 1/2 the welfare derivative is signed by:

$$\pi - \beta - \beta(1-\beta)3/2.$$

Now we solve for a quasi-reduced form in π as a function of β. We know that the predator allocation condition implies $(1-\pi)V^H = (1-\beta)V^L$. Linearity of demand and $\alpha = 1/2$ implies $V^H/V^L = 3$. The predator allocation condition then implies that $\pi = 2/3 + \beta/3$.and $\pi - \beta = (1-\beta)2/3$. Substituting into square bracket expression we obtain:

$$(2/3)(1 - \beta) - \beta(1-\beta)3/2.$$

As plotted in Figure 3, this expression can have either sign, depending on the free parameters which determine equilibrium β.

The critical interior value of β for which the derivative of welfare with respect to α is equal to zero is solved from
$(2/3)(1-\beta)-\beta(1-\beta)3/2=0.$, The solution is : $\{\beta = .44444\}, \{\beta = 1.0\}$. The diagram shows that cream skimming is the solution when the Mafia equilibrium value of β exceeds .44. For this range, social welfare is decreasing in α when evaluated at the Mafia solution. Social welfare is always decreasing in n at the Mafia solution.

We must check that positive profits are earned by the Mafia in this range. Mafia profits are given by $(\pi-\beta)\alpha V > fn = \pi(1-\pi)\alpha V$ where the latter equality follows from the optimal selection of n by the Mafia. The two conditions imply that positive profits require $\pi > \beta^{1/2}$. Combined with the predator allocation condition in the linear case, this means $-3\beta^{1/2}+\beta+2 > 0$. Figure 4 plots the left hand side as a function of β. This shows that for any value of β which emerges as an equilibrium value, Mafia profits are positive.

Figure 1. Net coalition profit as a function of w--Parameters values: f=aV/15; R=2, f/d=1

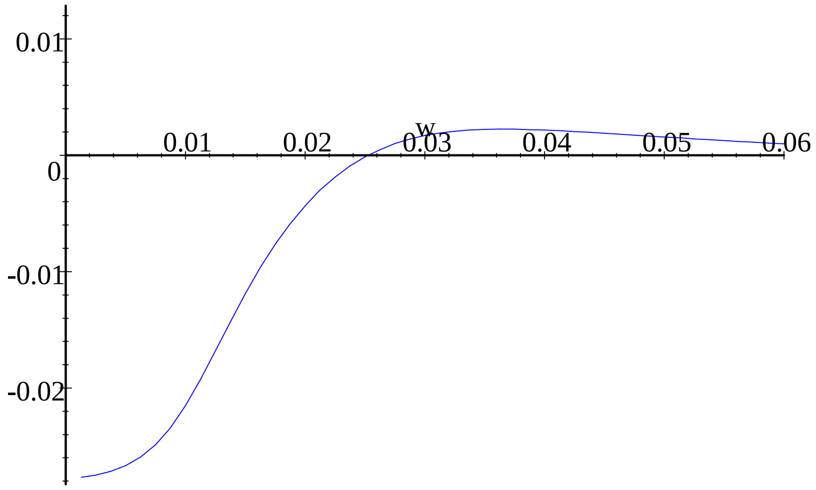


Figure 2. Net coalition profit as a fct of R-- Parameters values: f=aV/15;w=1/32, f/d=1

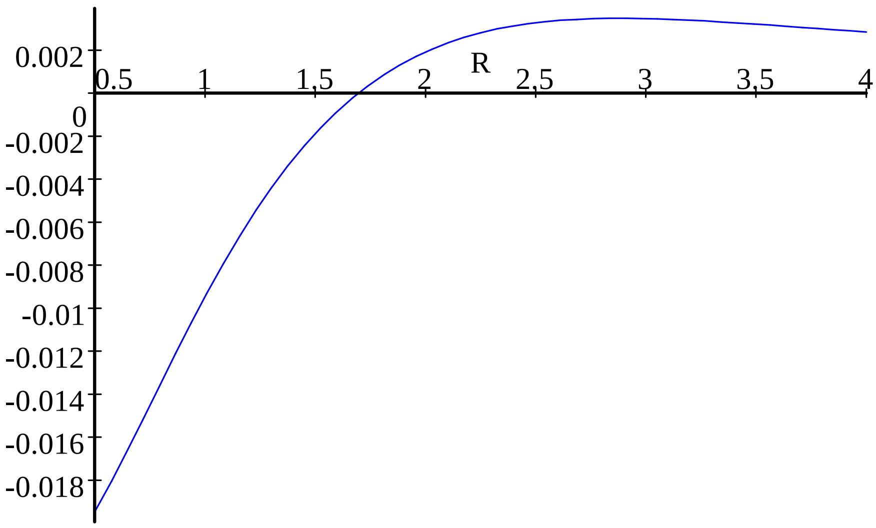


Figure 3: State Protection vs. Mafia Protection

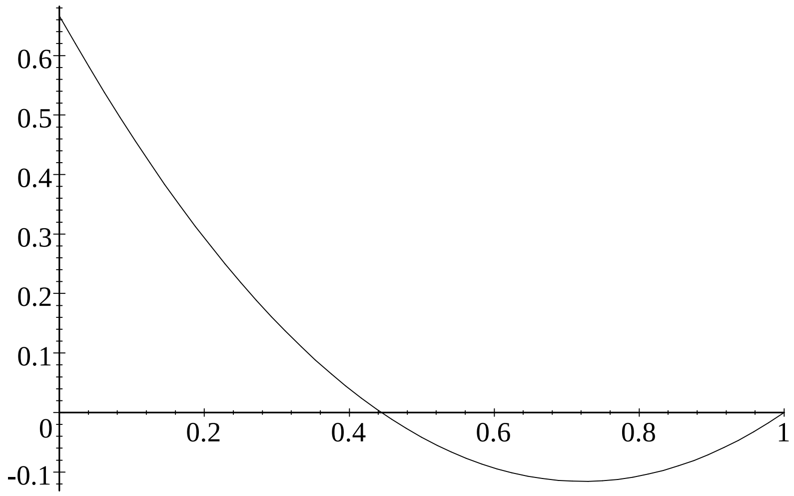
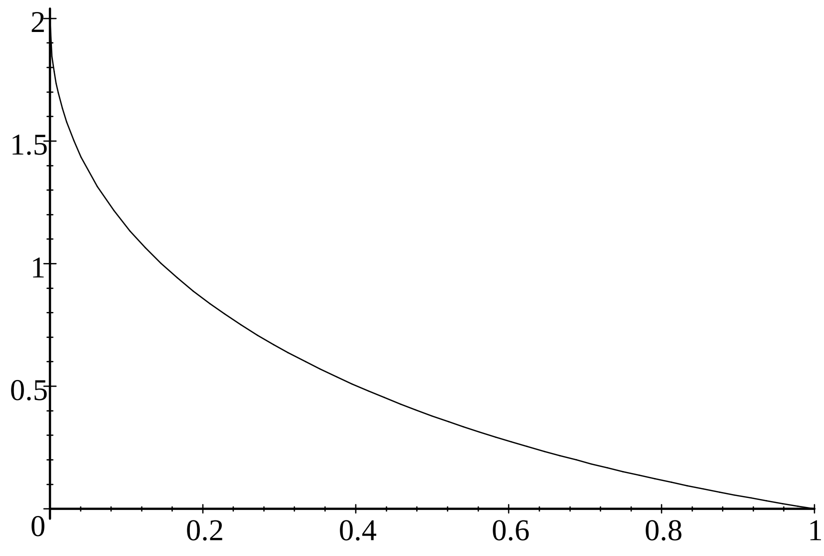


Figure 4: Profits as a function of beta.



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