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Predator or prey? Parasitic enterprises in economic development

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Abstract

In many developing and transition economies Mafia-like activities are rampant. Extortion and other forms of predation lower profitability in private businesses and distort investment incentives. Incorporated in a model of industrialization, bimodal club convergence may result. Economies may get stuck in a Predators' Club characterized by a vicious cycle of poverty and predation. Societies with a low flow of new entrepreneurs are especially vulnerable to predation and never get out of this club. Poor societies with a high flow of new entrepreneurs, however, may grow out of the trap and join the rich Producers' Club. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Predation takes many forms beyond simple theft. Criminals collect extortion money and are also paid to provide protection, to collect debt and to solve problems. In developing countries criminal predation activities are rampant and damaging. The plunderers include regular thieves, transformed rebel groups, middlemen and politicians. One strategy is straddling, whereby political insiders own firms that private sector companies have to consult and remunerate in order to have certain contracts signed and enforced (Bates, 1983; Bigsten and Moene, 1996). Also parts of Eastern Europe are severely affected. The institutional vacuum created by the collapse of communism has opened the scene for criminal predation (Skaperdas, 1999). In 1994 criminal gangs controlled

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40 000 Russian businesses (Campos, 2000). Extralegal contract enforcement has become routine. In fact, enterprises acquire information on each others' enforcement partners before entering into business agreements (Volkov, 1999).

To explore the causes and consequences of these forms of criminal predation we start out from the premisses that producers and predators are recruited from the same pool of entrepreneurs and that predators feed on producers' profits.¹ At a low level of development predation is more attractive than at higher levels of development. A country can therefore be trapped in a state where a high number of predators undermine the incentives of productive entrepreneurship. While these countries stagnate and remain poor, countries that avoid the trap grow fast and end up rich. We also show, however, that when the flow of new entrepreneurs is sufficiently high, it is possible for a country to move out of the trap and experience a delayed take off.

Like other models with multiple equilibria ours explains how similar societies may find themselves in quite unequal situations depending on initial conditions. Unlike other models, however, ours explains how the underdevelopment trap may be overcome by endogenous forces. The feature of multiple equilibria that may transform into an unique equilibrium at higher levels of development has interesting implications for economic convergence across countries. Some relatively poor countries may join the ranks of the rich, while some rich countries transit to being relatively poor. Thus our model generates dynamics where countries may go both from poor to rich and from rich to relatively poor. Initially poor countries may grow fast and outperform richer countries. One may end up in a polarized distribution where some countries are rich and some are poor, also denoted club-convergence or twin peaks dynamics (Quah, 1996a, b). In our case, we label the twin peaks Predators' Club and Producers' Club.

In order to establish these results we embed predatory activities within a dynamic general equilibrium model of industrialization. The basic model follows Murphy et al. (1989) where the degree of industrialization depends on the size of the market, and the size of the market depends on the degree of industrialization. We extend the model in two directions. First we include predation that lowers profitability of producers. Second we incorporate explicit dynamics by applying an economics twist to the well known predator-prey mechanism. Unlike in biology, entrepreneurs can choose whether to enter as predator or prey. A newborn cub cannot choose whether to become a fox or a rabbit, but a novice entrepreneur can decide whether to go into predation or production.

The root of the development problem that we study is weak law enforcement by the state. As neatly analyzed by Dabla-Norris and Freeman (1999) an inefficient legal system may in itself be explained by underdevelopment at the same time as underdevelopment is caused by insecure property rights. Except for a brief discussion (in Section 3.2) we abstract from variations in law-enforcement.

¹ In this respect our approach relates to the seminal papers on the misallocation of talent to unproductive activities by Usher (1987), Baumol (1990), Murphy et al. (1991, 1993), and Acemoglu (1995). See also Andvig (1997), Konrad and Skaperdas (1998), Grossman (1998), Chand and Moene (1999), Baland and Francois (2000), and Torvik (2002).

2. The economy

2.1. The productive sector

All goods are produced within the productive sector of the economy. With some modifications, our description of the productive part of the economy is that of Murphy et al. (1989). There is a given number, M , of different goods. Each good can be produced in a modern firm or in a competitive fringe with free entry. The fringe has a constant returns to scale technology where one unit of labor produces one unit of the good, fixing the real wage to unity. A modern firm produces y with the increasing returns to scale production function

$$y = \alpha(l - F) \quad \text{with } \alpha > 1 \text{ and } l \geq F, \quad (1)$$

where l is employment and F is a fixed cost in labor units. Assuming equal expenditure shares in consumption, unitary demand elasticity and Bertrand price competition it follows that: (i) all M goods have a price equal to one and are produced in equal quantities y ; (ii) each good is either produced entirely by the fringe or entirely by one single modern firm. To see this, observe that the fringe can always supply at a price equal to one. Price competition à La Bertrand implies that the price is set just below the marginal cost of the second most efficient competitor. A single modern firm in an industry only competes against the fringe and the price is set equal to one. With more than one modern firm in the same industry competition drives the price further down (to the lower marginal cost of modern firms). Hence, when two or more modern firms compete, all of them get negative profits, implying that only one firm will enter each branch of industry.

Each modern firm has a profit margin $\gamma = 1 - 1/\alpha$ and profits, before predation is taken into account, are therefore

$$\pi = \gamma y - F. \quad (2)$$

The production, y , of each of the M goods depends on the size of the market, represented by the total income of the economy, $Y = yM$. Total income is the sum of profit and wage income. Since firms in the fringe earn no profit, aggregate profits are $n_a \pi$ where $n_a \leq M$ denotes the number of productive modern firms. Since all workers, L , earn the same wage equal to one, total wage income is L . In general equilibrium total spending is equal to total income. Hence,

$$Y = yM = n_a \pi + L. \quad (3)$$

By solving for y from (2) and (3) we get

$$y = \frac{Y}{M} = \frac{\alpha(L - n_a F)}{\alpha(M - n_a) + n_a} = \frac{L - n_a F}{M - \gamma n_a} \equiv y(n_a). \quad (4)$$

If there are no modern firms, total income and production Y is equal to L . With full industrialization, $n_a = M$, total production equals $\alpha(L - MF)$. We assume that production (value added) in a modernized economy is higher than in a backward economy, i.e.

$$\alpha(L - MF) > L \Leftrightarrow \gamma L - MF > 0. \quad (5)$$

Note that (4) and (5) imply that demand for each good is increasing in the number of modern producers, $y'(n_a) > 0$. From (2) and (4) profits per modern enterprise (before predation) are

$$\pi = \frac{\gamma L - MF}{M - \gamma n_a} > 0. \quad (6)$$

Observe that π is increasing in the number of other modern firms n_a . As firms modernize they generate positive profits, pushing up demand and profits in all modern firms. Our model would, without predation, lead to full modernization.² However, as we shall see by incorporating predatory actions of extortion and protection in our model, productive entrepreneurs cannot expect to keep all profits for themselves and a development trap may result.

2.2. The predatory sector

Predation against productive firms takes many forms. Extortion and protection are obvious examples in societies where law enforcement is weak. While extortion implies use or threat of violence to obtain illegal rents, the economic gains from providing protection are compensation for defensive measures against other gangs. There are n_b predatory entrepreneurs. Hence the total number of entrepreneurs, predators and producers, is

$$n = n_a + n_b \leq M. \quad (7)$$

The latter inequality is imposed as we concentrate on development problems where there is a scarcity of entrepreneurial talent, n , relative to industrial opportunities, M . This implies that there is never congestion among productive entrepreneurs.

In case the firm is approached by a predatory enterprise, it chooses what is the cheapest of paying protection money and paying for self-defence. Self-defence requires a constant marginal cost of ϕ per unit of production y . Knowing this, a parasite preempts by asking for a share ϕy as extortion money. As a consequence self-protection is not chosen.

The probability of being approached by a parasite is denoted by μ . The expected profits net of protection money is thus given by

$$\pi_a = \pi - \mu\phi y = (\gamma - \mu\phi)y - F. \quad (8)$$

The probability μ can be defined as the number of extortion cases x divided by the number of productive firms. As in other matching processes x depends on the number of productive firms n_a and the number of predators n_b . At each point in time each predatory enterprise approaches only one productive firm. (The mechanisms are also easily extended to the case where each predator can extort more than one productive firm.) Assuming full information and no friction, x is then the lowest of n_a

² The poverty trap in Murphy et al. (1989) follows from their assumption about a wage premium in modern firms.

and n_b , and the probability of being approached $\mu = x/n_a$ simply becomes

$$\mu = \min[m, 1], \quad (9)$$

where $m = n_b/n_a$ is the predation intensity in the economy.

Like ordinary business operations parasitic activities require entrepreneurial effort and organizational skills. Unlike productive business operations, however, predation requires hardly any investment in physical capital in contrast to the fixed cost F in production. Parasites specialize in protection and may utilize efficient but illegitimate methods. They can therefore produce protection at a lower unit cost compared to the cost of self-defence. These characteristics are captured in the model by setting both fixed and marginal costs in predation to zero. Moreover, we also set the predator's probability of being punished equal to zero. Law enforcement is briefly discussed in Section 3.2.

The predator who is first to approach a productive firm is able to collect the protection money. The probability of being the first is equal to the number of extortion cases x divided by the number of predators n_b . This probability can also be expressed as μ/m . The expected profits to a predator can now be defined as

$$\pi_b = \frac{\mu}{m} \phi y. \quad (10)$$

The fraction $\mu/m = x/n_b$ also measures the congestion among the predators. There is no congestion and each predator can extort its productive firm without competition, $x = n_b$, when there are few predatory enterprises ($m < 1$ and $\mu/m = 1$). When there are fewer predatory than productive firms, each predator captures the whole amount paid in protection money. When n_b exceeds x (m exceeds one), congestion sets in, and π_b goes to zero as m goes to infinity. When there are more predatory enterprises than productive firms, some productive firms are approached by more than one predator. In that case the protection becomes effective and more protection money need not be paid. We assume in (10) that when some predators end up in conflict with others they do not waste resources in this conflict. Combining (8) and (10) it follows that

$$\pi n_a = \pi_a n_a + \pi_b n_b. \quad (11)$$

Hence, the gross profits are distributed to productive and predatory entrepreneurs without any loss.

The results of the model do not depend on the exact assumptions made above. One essential feature of the model is that profits to predatory enterprises go to zero when the predation intensity m is high. Several alternative specifications would yield this result. If the predatory enterprises had to fight over ϕy , predators' profits would still go to zero—only faster. For example, if protection of each productive firm is monopolized, new predatory enterprises have to fight for a footing or wait for a productive firm without protection to show up. Compared to (10), both these alternatives would lower expected profits to an entering predatory enterprise without changing the qualitative results. Taking account of the use of labor beyond entrepreneurial skills in the predatory sector would just strengthen the negative effect of predation on production.

Since a productive firm always has the option to close down, the fraction of extortion money ϕ must be sufficiently low to ensure that the productive firm receives positive

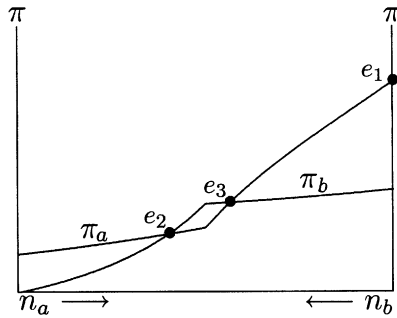


Fig. 1. Predator or prey—dual equilibria.

profits also after protection money is paid. The necessary condition for positive profits of an approached producer for all relevant levels of production y , is

$$\gamma > \frac{F}{L/M} + \phi. \tag{12}$$

This follows since the profit of an approached producer is $(\gamma - \phi)y - F$ and the lowest level of y is $y(0) = L/M$.

2.3. Allocation of entrepreneurs without entry and exit

What are the equilibrium allocations of a given number of entrepreneurs and what are the conditions for the existence of a development trap caused by predation? To answer these questions observe that a feasible equilibrium implies an allocation of n_a and n_b such that either profits are the same in both activities:

$$\pi_a = \pi_b, \tag{13}$$

or that production is more profitable than being the only predator:³

$$\pi_a > \pi_b \quad \text{and} \quad n_a > 0 = n_b. \tag{14}$$

To describe these equilibria we draw the profit curves (8) and (10) as in Figs. 1 and 2 where $n = n_a + n_b$ determines the width of the diagram. The profit curves π_a and π_b intersect twice, once (as a tangency) or not at all. Let us first consider the case where they cross twice as in Fig. 1.

In Fig. 1 the number of productive firms, n_a , are measured from left to right while the number of predatory enterprises, n_b , are measured from right to left. Let us start from the left. With only one productive firm and $n - 1$ predatory enterprises, the predation intensity m is high and the producer is approached with certainty ($\mu = 1$). As a result profits to a predatory enterprise are approximately zero. Profits to the productive firm are positive in accordance with the participation constraint (12). As the number of productive firms increases and the number of predatory enterprises declines, production

³ Due to (12) we can rule out the potential equilibrium case where $\pi_b > \pi_a$ and $n_b > 0 = n_a$.

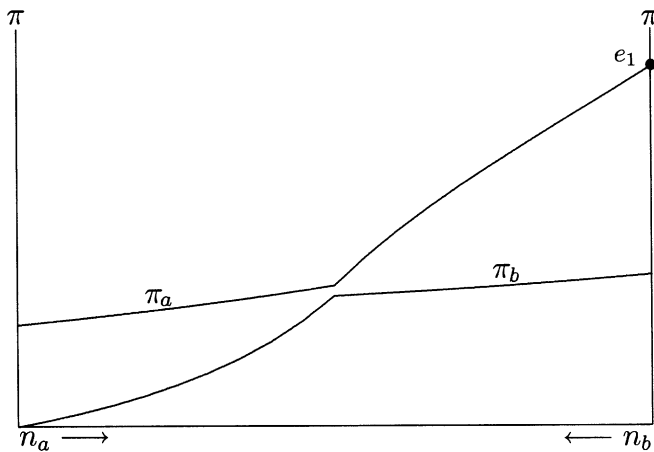


Fig. 2. Predator or prey—unique equilibrium.

goes up and profits increase in both activities. As long as $n_a < n_b$ (and therefore $m > 1$) the predatory enterprises enjoy an additional gain as the congestion among the predators gets less severe. At the point where $n_a = n_b$ (and thus $m = 1$), the congestion among predatory enterprises disappears. The profit curve of the predators levels out, as they only benefit from increased production. For the producers, however, the profit curve becomes steeper at $n_a = n_b$. Further increases in n_a implies that μ , the probability of being approached, starts to decline in tandem with the predation intensity m , giving an additional boost to profits in production.⁴ In Fig. 1 condition (13) is satisfied at e_2 and e_3 , while condition (14) is satisfied at e_1 . By assuming that entrepreneurs flow to the most profitable activity, the dynamics can be written as

$$\begin{aligned} \pi_a > \pi_b &\Rightarrow \dot{n}_a > 0 \quad \text{and} \quad \dot{n}_b < 0, \\ \pi_a < \pi_b &\Rightarrow \dot{n}_a < 0 \quad \text{and} \quad \dot{n}_b > 0. \end{aligned} \tag{15}$$

Thus in Fig. 1 e_1 and e_2 are locally stable equilibrium points while e_3 is an unstable tipping point. If the economy starts out to the right of e_3 , it ends up at the equilibrium point e_1 . If the economy starts out to the left of e_3 it ends up at e_2 . The level of modernization and income is lower at e_2 than at e_1 and we denote the equilibrium point e_2 a predation trap. The segment between e_2 and e_3 , where the economy moves towards e_2 , is denoted the poverty funnel. This discussion can be summarized as follows:

Proposition 1. *For any number of entrepreneurs n there is either one or two locally stable equilibria. (i) No predation, $n_b = 0$, is always an equilibrium. (ii) If and only if $\pi_a < \pi_b$ for $n_a = n_b$, there is also one locally stable equilibrium where $n_b > n_a$.*

⁴ With increasing returns in self-defence, in the sense that ϕ is decreasing in y , π_a would be steeper for all n_a while π_b would become less steep. The qualitative features illustrated in Fig. 1 would not be changed.

Proof. When $n_a = n$ and $n_b = 0$ it follows from (8)–(10) and (12) that $\pi_a = \gamma y(n) - F > \phi y = \pi_b$, which proves part (i). Part (ii) is proven in the appendix. \square

Part (i) of the proposition refers to e_1 in Fig. 1, while (ii) refers to the poverty trap e_2 in the figure. At the equilibrium point e_2 the condition (13) holds and there is congestion among the predators ($m > 1$) and producers are approached with certainty ($\mu = 1$). Inserting $\mu = 1$ in (8) gives us the following expression for the common profit at the equilibrium point e_2 :

$$\pi_a = \pi_b = (\gamma - \phi)y - F. \quad (16)$$

From (16) combined with (4) and (13) it follows that at e_2 profits in both activities increase when the extortion share, ϕ , declines or when the markup rate, γ , increases. Hence we have

Proposition 2. *In the predation trap improved efficiency in production (γ up or F down) and lower extortion (ϕ down) increase profitability both in production and extortion.*

It may be counter-intuitive that a lower extortion share implies higher profits to predatory enterprises. The reason is that a lower extortion share ϕ raises profits from production relative to predation, inducing entrepreneurs to move from predation to production. Hence, production increases and profits to each producer go up. The number of producers grows at the expense of predators until profits from predatory activities become as high as in production. To slightly rephrase Usher (1987, p. 241): Whatever harms the thief is beneficial both to the producer and the thief.

As stated in part (ii) of Proposition 1 the predation trap does not always exist. If $\pi_a > \pi_b$ for $n_a = n_b$, there is no trap. By using (8), (10), (4) and inserting for $n_a = n/2$ it follows that there is no trap if and only if

$$F < \frac{(\gamma - 2\phi)L}{M - \phi n}. \quad (17)$$

When F is sufficiently small it is always more profitable to produce than to predate. Thus economic expansions with a higher n can shift the economy out of the vicious predation cycle. The case with the trap is already illustrated in Fig. 1 where π_a and π_b cross twice. The alternative case, where π_a and π_b do not cross, is illustrated in Fig. 2.

Whether (17) holds or not depends on the total number of entrepreneurs n . We denote by \tilde{n} the highest number of entrepreneurs that can support dual equilibria. This threshold is derived from (17) as

$$\tilde{n} = \frac{FM - L(\gamma - 2\phi)}{F\phi} \equiv \tilde{n}(\phi), \quad (18)$$

where $\tilde{n}(\phi)$ is an increasing function. Clearly, we have a dual equilibria case only if $0 < n < \tilde{n}$. Hence, if $\tilde{n} < 0$ there is a unique equilibrium. It follows from (7) that if

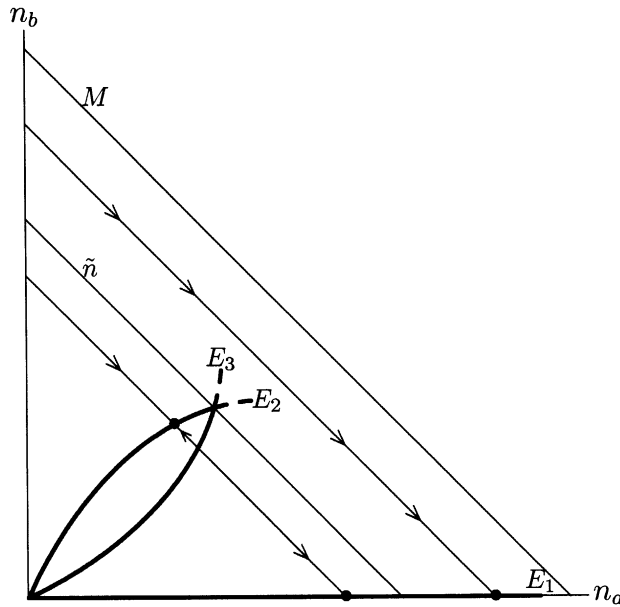


Fig. 3. Predator or prey—equilibria.

$0 < \tilde{n} < M$, there are dual equilibria for low levels of n , but not for high levels of n . Observe from (18) that

$$\begin{aligned} \phi &= (\gamma L - FM)/(2L) \equiv \bar{\phi} \Rightarrow \tilde{n} = 0, \\ \phi &= (\gamma L - FM)/(2L - FM) \equiv \hat{\phi} \Rightarrow \tilde{n} = M. \end{aligned} \tag{19}$$

Recall that with two equilibria one of them is a predation trap. By using (19) we have the following proposition.

Proposition 3. (i) *If the extortion share is low, $\phi < \bar{\phi}$, there is never a predation trap.* (ii) *If the extortion share is high, $\phi > \hat{\phi}$, there is always a predation trap.* (iii) *For intermediate values, where $\bar{\phi} \leq \phi \leq \hat{\phi}$, there is a predation trap if and only if n is low ($n \leq \tilde{n}(\phi)$).*

To illustrate part (iii) of the proposition consider Fig. 3. For each n there is a downward sloping 45° line, $n_b = n - n_a$. The arrows in the figure indicate the dynamics given by (15). The E_2 and E_3 curves are all combinations of n_a and n_b that solve the equilibrium condition (13). The E_2 curve represents the set of stable interior equilibria e_2 , while the E_3 curve represents the set of unstable tipping points e_3 . Finally, the no-predation corner solutions e_1 from (14) apply along the horizontal E_1 curve (where $n_a = n$ and $n_b = 0$). The curves E_2 and E_3 intersect for \tilde{n} below M . So if the given value of n is lower than the threshold \tilde{n} , there is a predation trap which ceases to exist if n exceeds \tilde{n} .

The location of the E_2 and E_3 curves is determined by the value of the extortion parameter ϕ . The two other parts of Proposition 3 can be visualized by shifting the E_2 and E_3 curves in Fig. 3: Case (ii) is obtained by raising ϕ such that the intersection defining \tilde{n} is moved to the right of M ; case (i) is obtained by lowering ϕ till the intersection between the E_2 and E_3 curves is moved to the origin.

3. Growth with entry and exit

3.1. The basic dynamics

In order to investigate the dynamics and the long run development path we specify in more detail the mechanism underlying the simple dynamic assumption in (15). Our approach is inspired by the predator–prey models (e.g. Lotka–Volterra, see Lotka, 1956) where the flow of novice entrepreneurs is θ , while the exit rate of entrepreneurs is δ :

$$\dot{n} = \theta - \delta n. \quad (20)$$

To simplify the presentation we make three assumptions that are later relaxed.

1. θ and δ are exogenous. In Section 3.2 we derive the implications when entry and exit depend on income and profitability.
2. The entrepreneurs' choice of which sector to enter is made once and for all. In Section 3.2 we consider the possibility of cross-overs at later stages.
3. Profit expectations are myopic. In Section 3.2 we consider forward looking expectations.

When the flow of new entrepreneurs θ and the exit rate δ are both exogenous, the limit of expansion of entrepreneurs, n^* , is equal to θ/δ . New entrepreneurs choose whether to go into productive or predatory activities depending on what activity yields the highest profit. Thus, we add best response entry to the predator–prey model; if $\pi_a \geq \pi_b$ all new entrepreneurs go into productive activity; if $\pi_a < \pi_b$, however, all new entrepreneurs go into predation. The assumption about a best response choice of activity produces completely different dynamics from Neher's (1978) Predator–Prey modeling of muggers and mugees. In Neher's model the growth of both types depends only on the absolute profitability of the respective activities. He gets high growth in the number of predators even when it is much more profitable to enter as prey.

The best response dynamics are

$$\begin{aligned} \pi_a \geq \pi_b &\Rightarrow \dot{n}_a = \theta - \delta n_a \quad \text{and} \quad \dot{n}_b = -\delta n_b, \\ \pi_a < \pi_b &\Rightarrow \dot{n}_a = -\delta n_a \quad \text{and} \quad \dot{n}_b = \theta - \delta n_b, \end{aligned} \quad (21)$$

which is consistent with the aggregate dynamics in (20). The phase diagram following from (21) is illustrated in Fig. 4. The movement is to the south-east except in the poverty funnel where the movement is north-west. Outside the poverty funnel profits are higher in legal than in illegal activities. All new entrepreneurs start as productive firms,

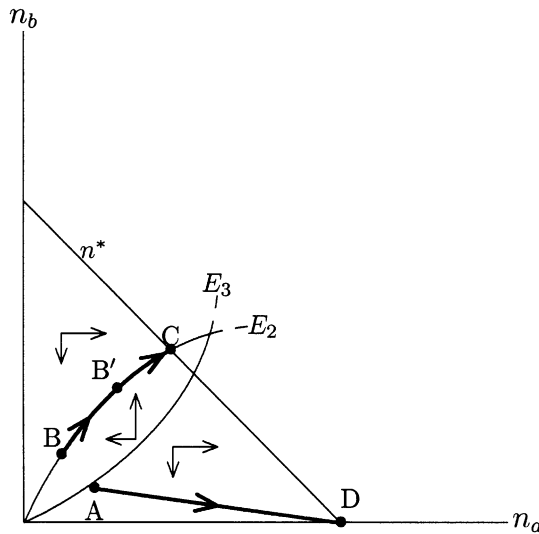


Fig. 4. Predator or prey—absolute poverty trap.

while the number of predators decreases by the rate δ . In the poverty funnel profits are lower in productive activities than in predation, and all new entrepreneurs choose to enter as predators. The number of predatory enterprises thus increases while the number of productive firms decreases. We focus our attention on situations with an initial number of entrepreneurs below the steady state number n^* , implying a development process with a growing number of entrepreneurs. The case where $n > n^*$ is briefly discussed in Section 3.2. Condition (7) implies that $n^* = \theta/\delta \leq M$. Fig. 4 illustrates the case where the flow of new entrepreneurs θ is low relative to the death rate δ , causing the limit of expansion n_1 to be lower than the threshold \tilde{n} . Fig. 4 also captures the essence of the case where $\tilde{n} > M$ and where the existence of a trap is unavoidable.

Once captured in a development trap, the economy remains trapped. For example, an economy starting out in B (country B) ends up in the trap C in the long run. From B, the new entrepreneurs enter into both activities. Thus, the number of producers as well as predators increases until the steady state number of entrepreneurs is reached. In country A, that starts to the right of the poverty funnel, however, all new entrepreneurs enter into productive businesses while predatory entrepreneurs gradually die out. Eventually country A ends up in D, a long run equilibrium without predation.

According to (4) total production $Y = n_a y(n_a)$ is increasing in the number of productive entrepreneurs. Knowing the path for productive entrepreneurs, the path for Y can be derived as in Fig. 5. The total number of entrepreneurs is the same in countries A and B. Because of the different initial predation rates, production in A is higher than in B. Furthermore, because B is in the predation trap it converges to a lower long run income level, Y_C , than country A, that asymptotically approaches Y_D . Country A both starts out and ends up with a higher income level than country B.

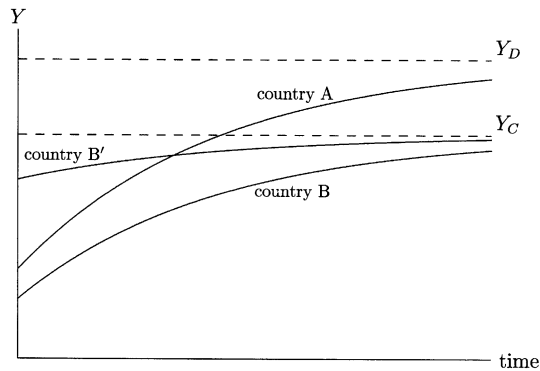


Fig. 5. An absolute poverty trap.

Consider next country B' in Fig. 4 that starts out with a higher number of productive entrepreneurs, and thus a higher income level, than both A and B. As this country is also in the predation trap it converges to Y_C , in spite of the high initial income level. Note that country A over time outperforms country B'. The reason is that A starts out free of the predation trap and therefore has a higher growth potential than country B'. Thus we have club convergence. Countries of type B and B' both end up at low income levels. They constitute the Predators' Club. Countries of type A, however, end up with high production and constitute the Producers' Club.

In the Predators' Club there is a vicious cycle of underdevelopment. Firms make low profits, production is low, and average income is low. Once the economy is in this bad equilibrium, predation hampers development and a low level of development invites predation. An entrepreneur does not take into account that by entering the productive sector, aggregate demand increases, shifting profit in favor of productive activities. Hence, predation creates externalities in addition to the demand externality in the basic model.

In the Producers' Club there is a virtuous cycle of development. Firms make high profits, production is growing and the average income is rising. Once the economy is on this good equilibrium path, predation is too low to prevent a beneficial development. Two positive externalities fuel the modernization. Entry of productive firms expand the market and boost the profitability of productive firms relative to predatory enterprises. As a consequence the number of predatory enterprises declines which further enhance profitability in production.

One interesting question is whether poor countries are more or less vulnerable to initial predation levels than richer countries. To answer consider again Fig. 4. Whether a country ends up in the Predators' Club or in the Producers' Club depends on the initial levels of both n_a and n_b . Any country, starting out below E_3 in Fig. 4, goes into the Producers' Club. Thus the predation intensity ($m = n_b/n_a$) that is implicitly defined by E_3 is the critical threshold value that determines the development path. Since the E_3 curve is convex it follows that the threshold value of m is increasing in the initial

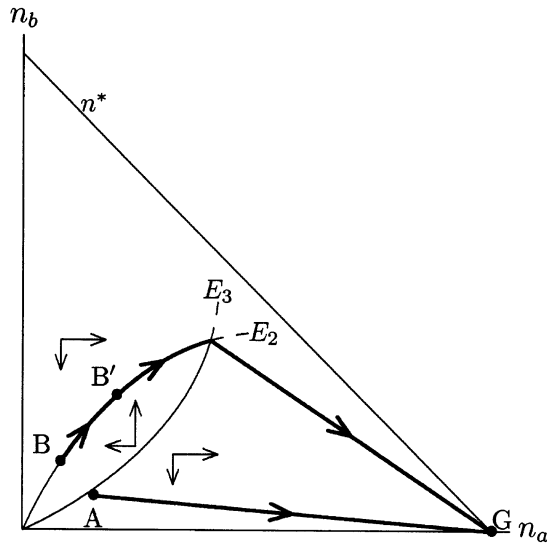


Fig. 6. Predator or prey—temporary poverty trap.

number of producers n_a and is therefore also increasing in the initial income level Y . Hence, the following proposition:

Proposition 4. *The highest predation intensity m that an economy can tolerate without slipping into the Predator’s Club is higher the richer the economy.*

Proof. By combining (9), (8), and (10) into the equilibrium condition (13) it follows that along E_3 the predation intensity is $m = ((\gamma - \phi) - F/y(n_a))/\phi$ which is increasing in n_a . \square

In the cases considered so far the predation trap can be avoided but not escaped once captured. This is not always the case. When the flow of new entrepreneurs θ , relative to the death rate δ , is sufficiently high for the limit of expansion n^* to be higher than threshold \tilde{n} , the economy eventually grows out of the trap. One example is provided in Fig. 6 where country B escapes the trap when the number of entrepreneurs has grown to a level beyond the poverty funnel. From this point all new entrepreneurs in country B enter productive businesses and the country ends up in the no-predation equilibrium G. The development trap is therefore only temporary. Unlike earlier models with multiple equilibria, such as those of Murphy et al. (1993) and Acemoglu (1995), the economy may thus endogenously grow out of a development trap.

Expanding economies may escape the predation-induced development trap because the profit in production is increasing in the scale of the productive economy, while predation has less of such a scale advantage. This difference in scale effects is even stronger when we take account of the reasonable assertion that law enforcement is more efficient in rich compared to poor countries. We return to the question of law enforcement below.

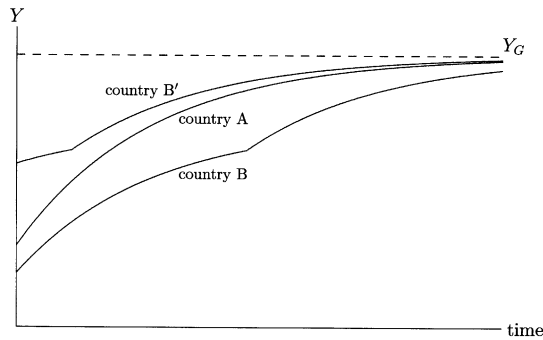


Fig. 7. A temporary poverty trap.

Time paths for country A, B, and B' are provided in Fig. 7. All countries eventually approach the same equilibrium income level, but the speed of convergence is different. Country A is the fastest grower. The reason is that in country A all new entrepreneurs become producers from the start, while country B and B' starts out in an interior equilibrium where, for an interval of time, only a fraction of new entrepreneurs become producers. Country A starts out and remains in Producers' Club. Country B' has a better performance than country B, as B' starts from a high level and soon shifts from Predators' Club to Producers' Club. Country B remains in Predators' Club for a longer time, but eventually shifts club. In the long run Producers' Club is the absorbing state for all countries. Yet country A and country B diverge for a while until convergence sets in. Thus we have long run convergence with endogenous club switching. We can summarize these results in the following proposition:

Proposition 5. *With a sufficiently high flow of new entrepreneurs, and $\tilde{n}(\phi) < M$, the economy will eventually move into the Producers' Club, irrespective of initial conditions. The transition is fastest if the economy starts out entirely free of the poverty trap.*

This prediction may appear overly optimistic. Note, however, that two conditions needs to be fulfilled in order for Proposition 5 to hold: First, as discussed in Section 2, in order to avoid the trap the extortion share must not be too high, so that threshold $\tilde{n}(\phi)$ from (18) is below M . Second, the growth of new entrepreneurs must be high (that is $n^* = \theta/\delta > \tilde{n}$). If these conditions are not met, it is not possible to escape the Predators' Club once trapped in it.

3.2. Law enforcement and alternative dynamics

In this section we consider some alternative assumption in order to check the robustness of the derived results. We also show that realistic extensions easily can be incorporated in the model.

3.2.1. Law enforcement

Effective law enforcement obviously reduces the profitability of predation. Law enforcement can be captured by letting ϕ be a decreasing function of expenses for law enforcement Z . Further, let Z be financed by a tax t on income in the modern sector, $Z = tyn_a$. The markup γ in the model is then replaced by $\gamma - t$, lowering profits from productive activities in (8) and where $t = Z/(yn_a)$. Hence, the required tax for a given quality of law enforcement is decreasing in the size of the modern sector. Efficient law enforcement in poor countries may require such a high tax rate t that the profitability of production gets too low to outperform predation. In a rich economy the tax base is higher, making law enforcement relatively cheaper. Dabla-Norris and Freeman (1999) provide an alternative discussion. In our context adding endogenous law enforcement implies decreasing returns in predation as the size of the market expands.

3.2.2. Endogenous entry and exit parameters

One way of making the entry parameter θ endogenous is to take into account that richer societies generate a higher flow of new entrepreneurs as education for the potential entrepreneurs is better. This can be captured by assuming that $\theta = \theta(y)$ where $\theta'(y) > 0$. Furthermore, in line with the gist of the original predator–prey models, the exit rate of entrepreneurs may go down as profits increase. Hence, $\delta_a = \delta(\pi_a)$ and $\delta_b = \delta(\pi_b)$ where $\delta'(\cdot) < 0$. These modifications are rather innocuous for the qualitative results. In the phase diagrams the new specification is mainly reflected in the shape of the limit of expansion of entrepreneurs,

$$\theta(y) = \delta(\pi_a)n_a + \delta(\pi_b)n_b. \tag{22}$$

As production y , according to (4), is an increasing function of the number of productive entrepreneurs n_a , Eq. (22) implicitly defines n_b as a function of n_a . This limit of expansion curve is neither linear nor necessarily everywhere downward sloping in the n_a – n_b plane.⁵ In other respects the phase diagram is not affected. Thus, the essential dynamics are not changed. Yet, the movements along the transition paths are of course affected by the endogeneity of the parameters. Consider, for example, country A and B in Figs. 6 and 7, which by construction have the same total number of entrepreneurs.

⁵ With endogenous parameters the limit of expansion has the slope

$$\begin{aligned} \frac{dn_b}{dn_a} &= -\frac{\delta(\pi_a) - \theta'(y)\partial y/\partial n_a - G_1}{\delta(\pi_b) + G_2}, \\ G_1 &= -\delta'(\pi_a)n_a \frac{\partial \pi_a}{\partial n_a} - \delta'(\pi_b)n_b \frac{\partial \pi_b}{\partial n_a} \geq 0, \\ G_2 &= \delta'(\pi_a)n_a \frac{\partial \pi_a}{\partial n_b} + \delta'(\pi_b)n_b \frac{\partial \pi_b}{\partial n_b} \geq 0. \end{aligned}$$

Hence dn_b/dn_a may be positive for some values of n_a and n_b . In Section 3, with exogenous parameters, the limit of expansion curve is linear as defined by $\theta = \delta[n_a + n_b] = \delta n^*$.

As country B is in the development trap it has lower initial growth than country A. When the entry of entrepreneurs depends on income this initial growth differential widens. In addition, the transition for country A is faster than for country B as the expected economic lifetime of predators is lower than that of producers.

3.2.3. *Cross-overs*

So far we have assumed that entrepreneurs choose their line of business once and for all. One modification is to allow one-way mobility only, in the form of a predation ratchet: Productive entrepreneurs may at any point in time switch from production to predation, but not the other way around. To go from predation to production is difficult when there is a stigma attached to illegal or amoral businesses. The inclusion of one-way mobility in the model is innocuous. When $\pi_b \leq \pi_a$, the predation ratchet is effective and the dynamics are as discussed above. When $\pi_b > \pi_a$, however, entrepreneurs instantly shift from productive to predatory businesses. Hence, countries that start in the poverty funnel instantly jump to the predation trap. From then on the dynamics are as already discussed.

The highest flexibility is obtained when there is frictionless movement of entrepreneurs in and out of any business activity. In this case the economy is always on either the E_2 or the E_1 curve. If the economy starts out to the left of the curve E_3 it jumps to E_2 while if it starts out to the right of E_3 it jumps to E_1 . Otherwise the dynamics are as discussed in Section 3.1. Thus, allowing some degrees of flexibility in cross-overs do not alter the main results, but may cause jumps in the transition path. With full mobility of entrepreneurs a good start yields an even better performance as the predators instantly switch to productive activities.

3.2.4. *Expectations*

Above we assumed myopic entry decisions among new entrepreneurs. Some degree of forward-looking or model based expectations lead to interesting modifications. Consider the case of a temporary development trap as country B in Fig. 6. In that case there is only one long run equilibrium; the one without predation. Productive entrepreneurs take this into account, even from the outset. Some entrepreneurs therefore choose productive businesses also in cases where the instant return to predation is higher. Thus, the area of the poverty funnel shrinks and a positive development is more likely. With sufficient weight on future gains combined with a long expected life (low δ) the poverty funnel may vanish all together, and the temporary predation trap disappears.

Allowing for degrees of optimism and pessimism, forward-looking behavior may give rise to self-fulfilling prophecies. Consider the case with two long run equilibria. If all entrepreneurs are optimistic and anticipate a long run movement towards the no-predation equilibrium this may lift the economy out of the predation trap, making the expectations self-fulfilling. Hence, again the poverty funnel shrinks. If entrepreneurs are generally pessimistic, however, we may end up in a self-fulfilling predation trap. Consider country A in Fig. 4, that with myopic expectations ends in the no-predation equilibrium D. If entrepreneurs are forward looking and anticipate a movement to the development trap C, they may choose predation even when productive entrepreneurship

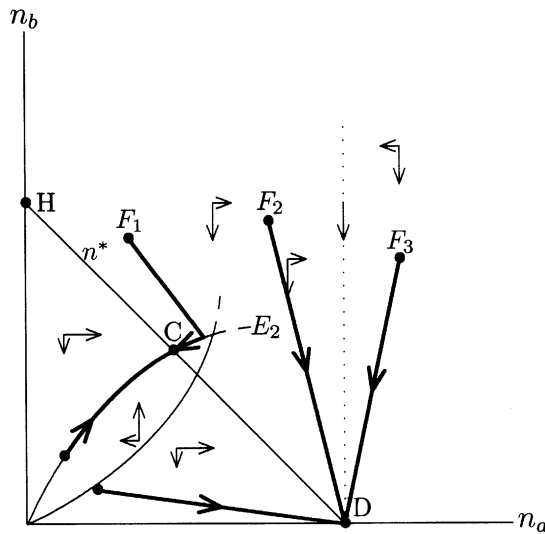


Fig. 8. Predator or prey—complete dynamics.

is relatively more profitable in the short run. Hence, the economy moves into the long run predation trap due to self-fulfilling pessimism. This implies that the poverty funnel expands with pessimistic expectations.

Combined with a one-way predation ratchet, however, the potential problem of self-fulfilling pessimism disappears. New entrepreneurs now always go into productive activities as long as the immediate return to producers are higher than the return to predators. One way mobility adds an option value on productive activities and may indeed help forming self-fulfilling optimism as entrepreneurs are less likely to choose predatory activities if they attach a positive probability on productive businesses being the most profitable choice in the long run.

3.2.5. The complete dynamics

In the preceding discussion we have focused on the reasonable case where the initial number of entrepreneurs is below n^* . For completeness we here also look at some possible cases when the economy starts out with a number of entrepreneurs above the steady state value. In Fig. 8 we consider the case of an absolute poverty trap and consider the dynamics as described by (21). Note first that the dynamics in (21) implies that outside the funnel the movement is along a straight line in the direction of D (where $n_a = n^*$ and $n_b = 0$). Inside the funnel the movement is along a straight line in the direction of the opposite point H (where $n_b = n^*$ and $n_a = 0$). This general rule holds as long as the path does not meet E_2 , from where the path goes to C. The income dynamics starting out from F_1 shows increasing income until the predation equilibrium is reached, then income goes down until the economy is stuck in steady state predation equilibrium C. Starting further to the right, in F_2 , the economy goes

clear of the predation trap and income grows steadily towards steady state D. Lastly starting even further to the right, in F_3 , the number of producers is higher than the sustainable level n^* . Even when all new entrepreneurs enter into productive activities, their number is not sufficient to replace the ones who disappear, and production declines until D is reached.

4. Concluding remarks

The state should have monopoly of legitimate violence with priorities of protection, taxation and law enforcement. In many societies, however, this Weberian ideal is not fulfilled. When the state cannot provide sufficient protection of property rights, economic incentives are shifted away from production and towards predation. Entrepreneurs find predation relatively more tempting at low income levels, since modern production has a larger scale advantage than predation. Our basic prediction is this: A low level of development implies that predation is both more harmful to the economy and more tempting to potential entrepreneurs. Predation may therefore both be a cause and a consequence of underdevelopment. Consequently the misallocation of entrepreneurial talent results in a poverty trap.

Predation has important consequences for the convergence across countries. Countries in the predation trap grow more slowly and their economic development converges, to a lower income level than countries that start out free of the trap. Some countries end up in the Predators' club with a low long run income level, while others end up in the Producers' club with a high long run income level. It is also possible for countries that start out in the Predators' club to join the Producers' club. For such endogenous club switching to happen, there must be a sufficiently high flow of new entrepreneurs.

Our model may be criticized for the unrealistic assumption that all entrepreneurs are completely without scruples. A less cynical and more realistic assumption is to have the entrepreneurs divided into three groups. In addition to the opportunistic entrepreneurs, there may be some completely honest and some completely dishonest. Whether this modification changes anything depends on the relative size of these groups. When there are some completely dishonest entrepreneurs there is predators also in the high income equilibrium. The predation trap, however, need not be affected. As long as there are enough opportunists for there to be opportunists both among the predators and the producers, the properties of the predation trap are not affected.

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Appendix

We shall prove the following result: *If and only if $\pi_a < \pi_b$ for $m = 1$, there is one locally stable equilibrium for $m > 1$.* (Proposition 1, Part (ii).)

Assume that there are interior equilibria. Let K indicate the number of interior equilibria and let $k=1 \dots K$ indicate the sequence of interior equilibria ranked according to the corresponding value of n_a . From (12) it follows that π_a is above π_b both when $n_a = 0$ and when $n_a = n$ and from (8) and (10) it follows that π_a and π_b both are continuous and everywhere increasing. Two facts follow:

- K is an even number.
- In the equilibrium $k = 1$ we have $\partial\pi_b/\partial n_a - \partial\pi_a/\partial n_a > 0$. Hence this equilibrium is locally stable. In the equilibrium $k = K$ we have $\partial\pi_b/\partial n_a - \partial\pi_a/\partial n_a < 0$. Hence this equilibrium is unstable.

Assume that there is an equilibrium for $m > 1$. Using (4), (8), (10), and the equilibrium condition $\pi_a = \pi_b$ it can be shown that in any equilibrium where $m > 1$,

$$\frac{\partial\pi_b}{\partial n_a} - \frac{\partial\pi_a}{\partial n_a} = \frac{\phi n(\alpha(M-n) + \phi\alpha n + n)}{(n-n_a)^2(\alpha(M-n_a) + n_a)^y} > 0.$$

The inequality follows as $M > n_a$ by definition. Hence, π_a can only cross π_b once for $m > 1$. Similarly, assume that there is an equilibrium for $m < 1$. Using (8), (10), and the equilibrium condition $\pi_a = \pi_b$ it can be shown that in any equilibrium where $m < 1$,

$$\frac{\partial\pi_b}{\partial n_a} - \frac{\partial\pi_a}{\partial n_a} = \frac{-\alpha n \phi L}{n_a^2(\alpha(M-n_a) + n_a)} < 0.$$

Hence, π_a can only cross π_b once for $m < 1$ and it follows that: (a) The maximum value of K is 2, (b) when $K = 2$ there is one and only one stable interior equilibrium which is found for an $m > 1$, and (c) $K = 2$ if and only if $\pi_b > \pi_a$ in the point where $m = 1$.

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