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Working Paper

Predator or prey? Parasitic enterprises in economic development

Memorandum, No. 2000,27

Provided in Cooperation with:

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Suggested Citation: Mehlum, Halvor; Moene, Karl; Torvik, Ragnar (2000) : Predator or prey? Parasitic enterprises in economic development, Memorandum, No. 2000,27, University of Oslo, Department of Economics, Oslo

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MEMORANDUM

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*By
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ISSN: 0801-1117

Department of Economics
University of Oslo

This series is published by the
University of Oslo
Department of Economics

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Predator or Prey?

Parasitic enterprises in economic development*

Halvor Mehlum[†], Karl Moene[‡] and Ragnar Torvik[§]

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 circle 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 high flow of new entrepreneurs, however, may grow out of the trap and join the rich Producers' Club.

Keywords: *Poverty traps, Club convergence, Organized crime*

JEL: *O1, O4*

*We thank Tor Jakob Klette for useful comments.

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1 Introduction

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. Violent gangs and criminal entrepreneurs not only extort and steal, but also provide protection, enforce contracts, and mediate disputes. "Problem solving" that normally belongs to the realm of the state, is undertaken by violent entrepreneurs and bandit gangs for money. Tributes are paid to avoid damage as criminals extort productive enterprises. Partnerships apply force on a commercial basis to collect debt and reduce transaction costs. As Konrad and Skaperdas (1998) observe, even in the most industrialized countries one find such backward forms of illegal activities, known as organized crime. The Sicilian Mafia and the American Mafia (Cosa Nostra) are well known examples. Similar rent seeking activities are also prevalent in developing countries and in the Eastern European transition economies.

Most often, however, rent seeking is thought of as activities directed towards an influential public sector where regulation and taxation invite wasteful influence activities by private businesses. We explore the opposite pole where weak public governance provides little protection of property rights. Inefficient law enforcement of this kind easily gives rise to unproductive rent seeking actions towards the business community itself.

In developing countries bandits not only control and protect small-scale informal enterprises such as street sellers and sweat shops. The surplus from large-scale modern firms are also dissipated by organized middlemen and professional plunderers. In some instances former youth gangs or rebel groups are transformed to criminal enterprises feeding on private businesses (Collier 2000). In other instances, political insiders set up their own firms that private sector companies have to consult and remunerate in order to have certain contracts signed. The latter type of activities, called straddling, constitute important forms of rent seeking in Africa. In Kenya, for example, president Moi allows extensive straddling among politicians and bureaucrats in exchange for loyalty to the government (Bates 1983, Bigsten and Moene 1996).

In Eastern Europe predatory enterprises belong to the growing shadow economy (Campos 2000). The institutional vacuum created by the collapse of communism has

opened the scene for extortion by commercial parasites. Illegal enforcement partnerships have become routine in Russian business activities. As Volkov explains

Before signing formal business contracts, companies acquire information on each other's enforcement partners ('whom do you work with?') and arrange a meeting between enforcement partners (strelka). Besides that, each of the participating sides would check whether the others really work with the group they claim to and would seek additional information about the real power (reputation as well as actual firepower) of that group. (Volkov 1999 p.746)

Both Eastern Europe and parts of the developing world seem to be trapped in a vicious circle of high crime and low growth. According to the Russian Ministry of Internal Affairs, criminal gangs in 1994 controlled 40000 Russian businesses (Volkov 1999).

In this paper we investigate the causes and consequences of such a vicious circle driven by criminal predation. Whether the predatory enterprises are best described as firms or as feudal kings, lords, and emperors, is debated.¹ Some Mafia organizations act like mini states that tax and protect commercial activities. Other types of parasitic enterprises are smaller and operate more like conventional firms. Common to all of them, however, is the profit motive. In our model the predators are profit seekers. We focus on the behavior of entrepreneurs who can run either parasitic enterprises or productive firms. Those who become parasites extort productive firms but do also (as in the model of Konrad and Skaperdas 1998) provide protection against extortion by other parasites.

In order to identify the harm of predation on economic development in poor countries we embed predatory activities within a dynamic general equilibrium model of industrialization. The basic model follows Murphy, Shleifer, and Vishny (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. Predation becomes particularly harmful when production and predation compete for scarce entrepreneurial resources. We therefore study the mechanism that allocates a limited number of entrepreneurs between the two activities. In this respect our approach relates to the

¹See for example Schelling (1971), Gambetta (1993), Fiorentini and Peltzman (1995), and Skaperdas (1999). For an excellent review of the economics of crime in general see Glaeser 1999.

seminal papers on the misallocation of talent to unproductive activities by Usher (1987), Baumol (1990), Murphy, Shleifer, and Vishny (1991 and 1993), and Acemoglu (1995).²

The second extension to Murphy, Shleifer, and Vishny (1989) is to incorporate explicit dynamics to the flow of new entrepreneurs. Here we apply 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.

One may think that it is a dominant strategy of entrepreneurs to enter into production with modern technologies when the number of entrepreneurs is low. This intuition is not generally true. With few entrepreneurs the size of the market becomes small which again limits the profits from entering production. To enter predation, however, normally involves lower fixed costs and therefore becomes relatively more tempting at low levels of development. Thus, when productive entrepreneurship is most needed, it may be most difficult to achieve it.

As a result an underdevelopment trap may emerge. A low level of development may, on the one hand, make venal activities within the business community relatively attractive for profit seeking agents. On the other hand, growth and development may be retarded by high (initial) levels of venal practices within the business community. Accordingly the economy can get stuck in a trap where a high number of predatory enterprises undermine the profitability of productive entrepreneurship. As a result, production is stagnating at a low level. Whether an economy ends up in the trap or not, depends on the degree of predation at the initial level of development. Within the trap what is good for production is also good for predation, which may explain why it is so difficult to get rid of parasitic enterprises.

Like other models with multiple equilibria ours explain how otherwise equal societies may find themselves in quite unequal situations due to differences in initial conditions. Unlike other models, however, ours explains how the underdevelopment trap may be annihilated by the endogenous entry of entrepreneurs. The different economies of scale in production and predation makes the trap disappear when the total number of entrepreneurs is high enough. Once this threshold of entrepreneurship is reached even

²See also Andvig (1997), Grossman (1998), Chand and Moene (1999), and Baland and Francois (2000).

countries that were caught in the trap will escape it. Hence, when the growth in the number of entrepreneurs is sufficiently strong the economy's multiple equilibria property disappears and only the no predation equilibrium remains.

The feature of multiple equilibria that may transform into a unique equilibrium at higher levels of development have interesting implications for economic convergence across countries. In poor societies with relatively much predation, modernization evolves slowly and economic growth is low. If the flow of new entrepreneurs is low these countries end up relatively poor irrespective of their initial income levels. Societies that start their modernization with a lower number of unproductive rent seekers within the business community, are likely to grow faster and end up richer. Some relatively poor countries 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.

If the flow of new entrepreneurs is sufficiently high, however, all countries end up in the Producers' Club. Societies that start modernization with many predators, experience a first phase where predation activities expand together with new modern activities. In the second phase the development trap is annihilated and predation vanishes as modernization continues. Thus, due to endogenous club switching the Producers' Club is the absorbing state.

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 4 we abstract from variations in law-enforcement.

The rest of the paper is organized as follows: Section 2 presents the basic model of the productive and predatory activities, and derives the allocation of entrepreneurs between activities. Section 3 discusses best response entry of entrepreneurs and dynamic implications. Section 4 concludes by a discussion of possible extensions.

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 similar to that in Murphy, Shleifer, and Vishny (1989). There is a given number, M , of different goods produced. Consumers have Cobb-Douglas utility, so all goods have equal expenditure shares and unitary demand elasticity. In each branch of industry there is a competitive fringe with a constant returns to scale technology and zero profits. The goods can also be produced with a modern, increasing returns, technology. Once a modern firm has entered a branch of industry, Bertrand competition prevents further entry. Moreover, competition from the fringe fixes the price that the modern firm can charge. The price equals the income per worker in the fringe, and is normalized to one. Modern production requires a fixed cost of F units of labor while the marginal productivity is $\alpha > 1$. The real wage is equal (to one) in all activities. Thus each modern firm has a fixed markup $\gamma = 1 - 1/\alpha$ and its gross profits (before predation is taken into account) are

$$\pi = \gamma y - F \tag{1}$$

when producing y .

The production of each good depends on the size of the market, represented by the total income of the economy, Y . Production of all M goods is given by y , and total spending and income is thus $Y = yM$. 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 the wage is one for all workers total wage income is simply equal to L . In general equilibrium total spending is equal to total income. Hence,

$$Y = yM = n_a\pi + L \tag{2}$$

By solving for y from (1) and (2) we get

$$y = \frac{Y}{M} = \frac{\alpha(L - n_a F)}{\alpha(M - n_a) + n_a} \quad (3)$$

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

$$\alpha(L - MF) > L \quad (4)$$

Then it also follows that modernization generates higher profits. From (1) and (3) gross profits per modern enterprise is

$$\pi = \frac{\alpha(L - MF) - L}{\alpha(M - n_a) + n_a} > 0 \quad (5)$$

Observe that condition (4) is sufficient for π to be 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.³ 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 result 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. 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 ϕy in protection money. As a consequence self-protection is not chosen.

³The poverty trap in Murphy, Shleifer, and Vishny (1989) follows from their assumption about a wage premium in modern firms.

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

$$\pi_a = \pi - \mu\phi y = (\gamma - \mu\phi) y - F \quad (6)$$

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

$$\mu = \min [m, 1] \quad (7)$$

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 4.

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

$$\pi_b = \frac{\mu}{m}\phi y \quad (8)$$

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 n_b exceeds x (m exceeds one), congestion sets in, and π_b goes to zero as m goes to infinity. In case 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 needs not to be paid. When there are fewer predatory than productive firms, each predator captures the whole amount paid in protection money. When there are more predatory enterprises than productive firms, some predators end up in conflict with others. In (8) we assume that they do not waste resources in this conflict. Combining (6) and (8) it follows that

$$\pi n_a = \pi_a n_a + \pi_b n_b \tag{9}$$

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

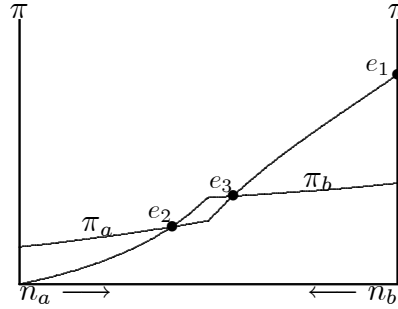
The results of the model do not depend on the exact assumptions made above. One essential feature of the model is that profits to predatory enterprises go to zero when the predation intensity m is high. Several alternative specifications would yield this result. If the predatory enterprises had to fight 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 (8), 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 profits also after protection money is paid ⁴

$$\pi_a > 0 \iff \gamma > \frac{F}{y} + \phi \tag{10}$$

⁴It follows from (3) with $n_a = 0$ that a sufficient condition for (10) to apply for all relevant y is that $\gamma > \frac{MF}{L} + \phi$.

Figure 1: Predator or prey - dual equilibria



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

$$\pi_a = \pi_b \tag{11}$$

or that production is more profitable than being the only predator

$$\pi_a > \pi_b \text{ and } n_a > 0 = n_b \tag{12}$$

To describe these equilibria we draw the profit curves (6) and (8) as in Figure 1 and Figure 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 Figure 1.

In Figure 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, m is high while $\mu = 1$. As a result profits to a predatory enterprise are approximately zero. Profits to the productive firm are positive in accordance with the participation constraint (10). As the number of productive firms increases and the number of predatory enterprises declines, production 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 by a predatory enterprise, starts to decline in tandem with m , giving an additional boost to profits in production.⁵ In Figure 1 condition (11) is satisfied in e_2 and e_3 while condition (12) is satisfied in e_1 . Assuming that entrepreneurs flow to the most profitable activity:

$$\begin{aligned} \pi_a > \pi_b &\Rightarrow \dot{n}_a > 0 \text{ and } \dot{n}_b < 0 \\ \pi_a < \pi_b &\Rightarrow \dot{n}_a < 0 \text{ and } \dot{n}_b > 0 \end{aligned} \tag{13}$$

Thus in Figure 1 e_1 and e_2 are 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 in e_1 . If the economy starts out to the left of e_3 it ends up in e_2 . As the level of modernization and income is lower in e_2 than in e_1 we label e_2 a development trap. The segment between e_2 and e_3 , where the economy moves towards e_2 , is denoted the poverty funnel.

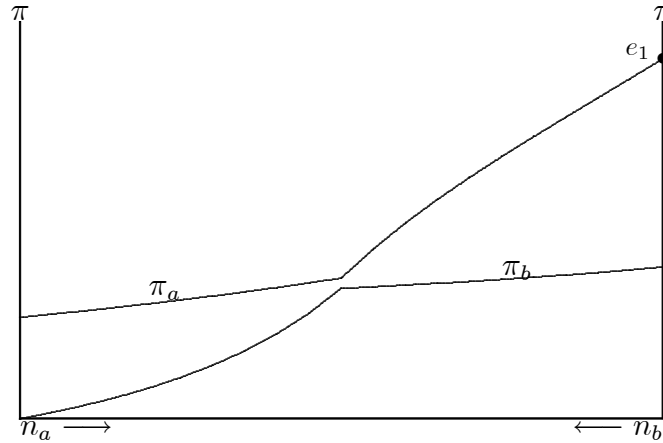
In the development trap e_2 the equilibrium condition (11) holds and there is congestion among the predators, $m > \mu = 1$. Inserting $\mu = 1$ in (6) gives us the following expression for the common profit in e_2

$$\pi_a = \pi_b = (\gamma - \phi)y - F \tag{14}$$

It follows that in e_2 profits in both activities increase when the extortion share, ϕ , declines or when the markup rate, γ , increases. Thus both producers and predators are better off if extortion becomes less efficient. It may be counter-intuitive that a lower extortion share implies higher profits to predatory enterprises. The reason is that a lower 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 grow at the expense of predators until profits from predatory activities

⁵With 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 picture in Figure 1 would not be changed.

Figure 2: Predator or prey - unique equilibrium



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.

The development trap can, however, under certain conditions be ruled out. In the case where the profit curves do not intersect or are tangents, the intersection e_2 disappears and e_1 remains as the only stable equilibrium. Condition (10) assures that profits are higher in production than in predation ($\pi_a > \pi_b$) both when the intensity of predation is high ($m \rightarrow \infty$) and when it is low ($m = 0$). Thus whether the two curves cross twice or not at all depends on the results for intermediate levels of predation. Noting that the difference $\pi_a - \pi_b$ is minimized when $n_a = n_b$ (i.e. $m = 1$), it follows from equations (6) and (8) that

$$\begin{array}{l}
 \frac{F}{y} > \gamma - 2\phi \\
 \frac{F}{y} \leq \gamma - 2\phi
 \end{array}
 \iff
 \begin{array}{l}
 \pi_b > \pi_a \\
 \pi_b \leq \pi_a
 \end{array}
 \iff
 \begin{array}{l}
 \text{cross twice} \\
 \text{do not cross}
 \end{array}
 \iff
 \begin{array}{l}
 \text{dual equilibria} \\
 \text{unique equilibrium}
 \end{array}
 \quad (15)$$

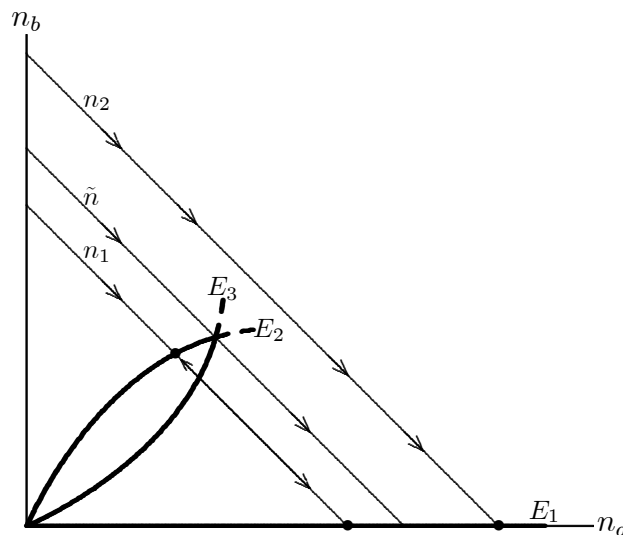
The first case is already illustrated in Figure 1 where π_a and π_b cross twice. The second case, where π_a and π_b do not cross, is illustrated in Figure 2. As reflected in the widths of the diagrams, the total number of entrepreneurs is higher in Figure 2 than in Figure 1. When n and therefore also y is high, the burden of fixed costs relative to production (F/y) is low. Condition (15) implies that the profit curves do not intersect for low F/y as long as

$$\gamma - 2\phi > 0 \quad (16)$$

When (16) is satisfied, expansion in the number of entrepreneurs may move the economy from the dual equilibria case to the unique equilibrium case. We denote the highest number of entrepreneurs that can support dual equilibria \tilde{n} . When $n < \tilde{n}$ there are two locally stable equilibria, the development trap with predation, e_2 , and the one without predation, e_1 . When $n > \tilde{n}$ there are only one equilibrium, the one without predation. With sufficiently high demand, it is always more profitable to produce than to predate. Thus economic expansion can shift the economy out of the vicious predation circle.

A complete description of the equilibria for different n is given in Figure (3). For

Figure 3: Predator or prey - equilibria



each n there is a downward sloping 45 degree line, $n_b = n - n_a$. The E_2 and E_3 curve are all combinations of n_a and n_b that solves the equilibrium condition (11). 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 (12) apply along the horizontal E_1 curve where $n_a = n$ and $n_b = 0$. The slope of the E_2 curve decreases as n increases. To see why we combine (6) and (8) and $\mu = 1$ to obtain

$$\frac{n_a}{n_a + n_b} = \frac{(\gamma - \phi)y - F}{\gamma y - F} \quad (17)$$

When n_a and n_b increase with n the right hand side goes up as y goes up. Hence n_a increases relatively more than n_b . The economic explanation for this is increasing returns to scale in production. Then, if the economy expands with a given relative allocation of entrepreneurs between production and predation, profits increase the most in production.

To fulfill the arbitrage condition (11) entrepreneurs must flow out of predation and into production. In contrast, tipping points involve more predators relative to productive firms as n increases, and the slope of the E_3 curve increases with n . To see why we do as in the calculation of (17) above, but now with $\mu = m$.

The E_2 and E_3 curves eventually converge for $n = \tilde{n}$ provided that (16) is satisfied. If (16) does not hold, however, E_2 and E_3 never converge and the poverty funnel extends to all possible n . The arrows in the figure indicate the dynamics as given by (13).

When the number of entrepreneurs is fixed at a low level, $n_1 < \tilde{n}$, there are two stable equilibria along the n_1 line as in Figure 1. When the number of entrepreneurs is fixed and high, say at $n_2 > \tilde{n}$ as in Figure 2, only the no-predation equilibrium E_1 remains.

3 Growth with entry and exit

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 (13). 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 :

$$\dot{n} = \theta - \delta n \tag{18}$$

To simplify the presentation we make three crude assumptions that are all relaxed in Section 4.

1. θ and δ are exogenous. In Section 4 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 4 we consider the possibility of cross-overs at later stages.
3. Profit expectations are myopic. In Section 4 we consider forward looking expectations.

When θ and δ are exogenous, the limit of expansion of entrepreneurs, n^* , is determined by the growth relative to the death rate, θ/δ .⁶ New entrepreneurs choose whether to

⁶Since we focus on societies with a limited entrepreneurial capacity, we only consider cases where $n^* < M$, assuring that there is always an unrealized potential for modernization.

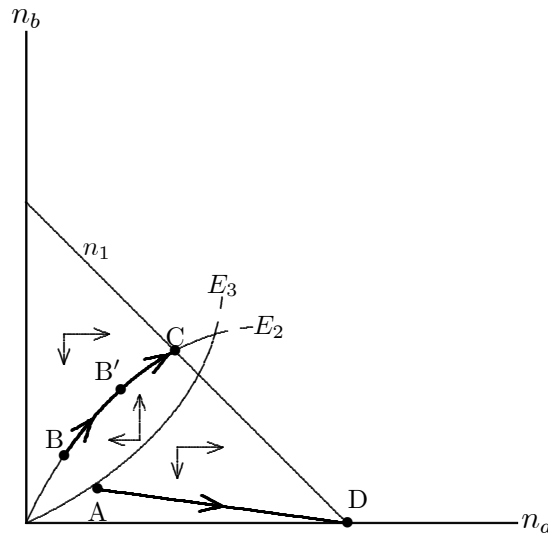
go into productive or predatory activities depending on what activity that yields the highest profit. Thus, we add best response entry to the predator-prey model. Hence, if $\pi_a \geq \pi_b$ all new entrepreneurs go into productive activity. If $\pi_a < \pi_b$, however, all new entrepreneurs go into predation. The assumption about a best response choice of activity produces completely different dynamics from Neher's (1978) Predator-Prey modelling 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's much more profitable to enter as prey.

The best response dynamics is

$$\begin{aligned} \pi_a \geq \pi_b &\Rightarrow \dot{n}_a = \theta - \delta n_a \text{ and } \dot{n}_b = -\delta n_b \\ \pi_a < \pi_b &\Rightarrow \dot{n}_a = -\delta n_a \text{ and } \dot{n}_b = \theta - \delta n_b \end{aligned} \tag{19}$$

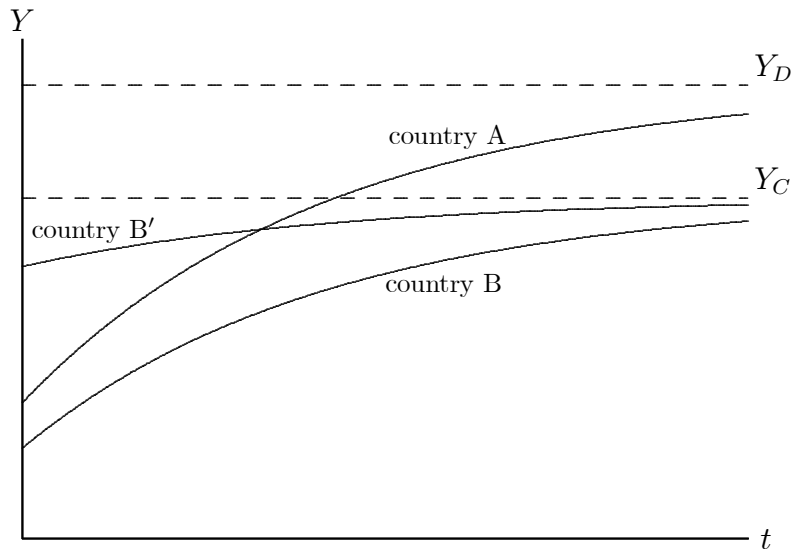
which is consistent with the aggregate dynamics in (18). The phase diagram following from (19) is illustrated in Figure 4. The movement is to the south-east except in the

Figure 4: Predator or prey - absolute poverty trap



poverty funnel where the movement is north-west. Outside the poverty funnel profits are higher in legal than in illegal activity. All new entrepreneurs start productive firms, while the number of predators decreases by rate δ . In the poverty funnel profits are lower in productive activity 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. As long as the total number of entrepreneurs is below its

Figure 5: An absolute poverty trap



maximum level, $n^* = n_1$, there is a net growth in the number of entrepreneurs. Figure 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} . Figure 4 also captures the essence of the case where E_2 and E_3 never converge and \tilde{n} approaches infinity.

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 (3) total production Y is increasing in the number of productive entrepreneurs. Knowing the path for productive entrepreneurs, the path for Y can be derived as in Figure 5. The total number of entrepreneurs is the same in country 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.

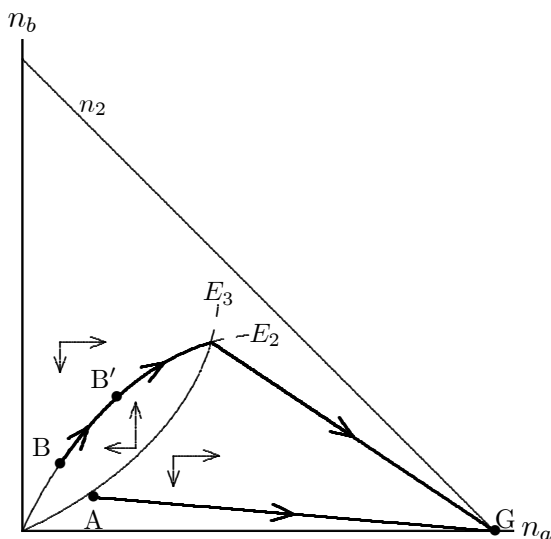
Consider next country B' in Figure 4 that starts out with a higher number of productive entrepreneurs, and thus a higher income level, than both A and B. As this country is also in the predation trap it converges to Y_C , in spite of the high initial income level. Note that country A over time outperforms 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 circle 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 circle 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.

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, the limit of expansion n^* is higher than \tilde{n} , and the economy eventually grows out of the trap. One example is provided in Figure 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, Shleifer, and Vishny (1993) and Acemoglu (1995), the economy may thus endogenously grow out of a development trap.

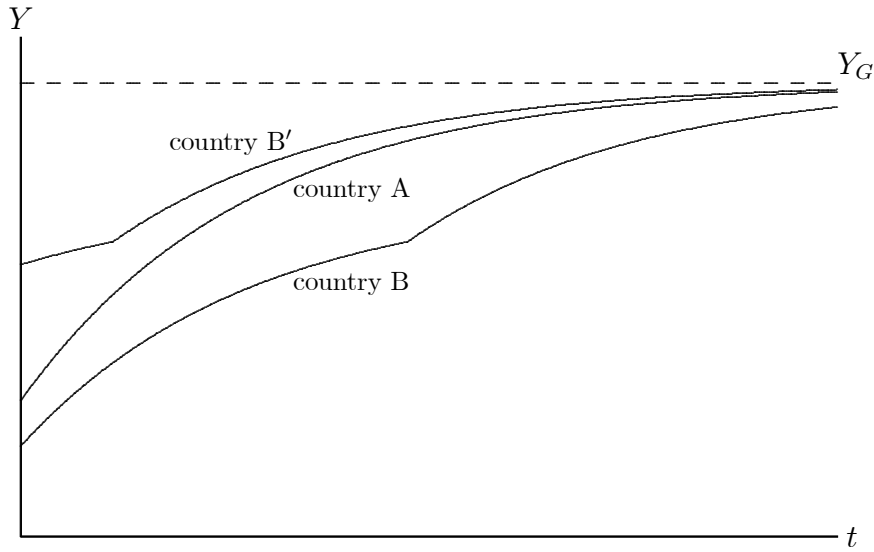
Figure 6: Predator or prey - temporary poverty trap



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 no such scale advantage. This difference in scale effects are 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 in Section 4.

Time paths for country A, B, and B' are provided in Figure (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.

Figure 7: A temporary poverty trap



4 Extensions

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.

Endogenous entry and exit parameters One way of making the entry parameter θ endogenous is to take into account that richer societies generates 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

$$\theta(y) = \delta(\pi_a) n_a + \delta(\pi_b) n_b \tag{20}$$

As y , according to (3), is an increasing function of n_a , equation (20) 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.⁷ 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 Figure 6 and Figure 7, which by construction have the same total number of entrepreneurs. 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 towards the full modernization equilibrium is faster as the expected economic lifetime of predators is lower than that of producers.

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. 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

⁷With endogenous parameters the limit of expansion has the slope

$$\frac{dn_b}{dn_a} = -\frac{\delta(\pi_a) - \theta'(y) \frac{\partial y}{\partial n_a} - G_1}{\delta(\pi_b) + G_2}$$

$$G_1 = -\delta'(\pi_a) n_a \frac{\partial \pi_a}{\partial n_a} - \delta'(\pi_b) n_b \frac{\partial \pi_b}{\partial n_a} \geq 0$$

$$G_2 = \delta'(\pi_a) n_a \frac{\partial \pi_a}{\partial n_b} + \delta'(\pi_b) n_b \frac{\partial \pi_b}{\partial n_b} \geq 0$$

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 $\theta = \delta[n_a + n_b] = \delta n^*$.

entrepreneurs a good start yields an even better performance as the predators instantly switch to productive activities.

Scruples The assumption that all entrepreneurs choose the business that yields the highest profits may also be modified. Including a moral cost for those who enter into predation would work as a downward shift in profits from predation. More interesting is the situation where entrepreneurs can be divided in three groups where, in addition to the opportunistic entrepreneurs, there are some completely honest and some completely dishonest entrepreneurs. Whether this modification changes anything depends on the relative size of these groups and on which group that contains the marginal entrepreneur. When some entrepreneurs are completely dishonest also the high income equilibrium would contain predators. In the development trap, however, the equilibrium allocation could well remain unaffected. As long as there are opportunists both among the parasites and the producers the equilibrium allocation is not affected.

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 Figure 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 Figure 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 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 not likely to choose productive activities if they attach a positive probability on productive businesses being the most profitable choice in the long run.

Law enforcement Effective law enforcement obviously reduce 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 (6) 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. That t is decreasing in n_a and y gives additional reasons why there may be a development trap caused by predation. 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.

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