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Conference Paper

How to Tackle the Gulf of Aden Buccaneers

Proceedings of the German Development Economics Conference, Hannover 2010, No. 31

Provided in Cooperation with:
Research Committee on Development Economics (AEL), German Economic Association

Suggested Citation: Calahorrano, Lena; an de Meulen, Philipp (2010) : How to Tackle the Gulf of Aden Buccaneers, Proceedings of the German Development Economics Conference, Hannover 2010, No. 31, Verein für Socialpolitik, Ausschuss für Entwicklungsländer, Göttingen

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How To Tackle the Gulf of Aden Buccaneers

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May 31, 2010
Preliminary version
Please do not quote

Abstract

The surge of maritime piracy in the Gulf of Aden is often related to lawlessness and poverty in Somalia. We set up a simple model to describe the choice of becoming a pirate in a setting with an industrialized and a developing country which both engage in fishing in the same waters. As a result of fishing competition, maritime piracy as an alternative to fishing becomes more attractive in the developing country. We further investigate possible measures for the industrialized country to deal with piracy.

JEL classification: F22, D78, P48
Keywords: Maritime Piracy, Expropriation, Migration

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> To board the Sirius Star, one of the world's largest oil tankers, Somali pirates had to haul themselves up ropes tied to grapnel hooks the height of London's Big Ben, with the 330-meter (1,100 feet) long ship pitching all the while in the tropical swell. Then there was the location, way out in the high seas, fully 450 nautical miles off the coast of Kenya. The feat of vertiginous thuggery will be taken everywhere as proof of what is possible; it was the biggest ever catch by any pirate, anywhere in the world.
>
> – *Economist*, November 20, 2008

1 Introduction

Maritime piracy in the Gulf of Aden and the Indian Ocean has in the last years become a growing concern for the Western world. On November 20, 2008, the *Economist* wrote that "the attacks [by Somali pirates] increase the threat against merchant shipping to levels not seen since the second world war." On November 30, 2009, UN Security Council Resolution 1897 (2009) prolonged for another year the rights of other States to "enter the territorial waters of Somalia" and to "use all necessary means to repress acts of piracy", initially granted for a period of six months by UN Security Council Resolution 1816 (2008).

The surge of piracy off the Somali coast is certainly related both to the limited capacity of its Transitional Federal Government to impose law and order and to limited economic opportunities and poverty of its people. Furthermore, lawlessness has apparently facilitated overfishing by rich countries, further reducing the economic opportunities of local fishermen.

In our paper, we set up a simple theoretical model of an industrialized and a developing country which both fish in the same waters to shed light on different short or medium term measures the industrialized country may take to counter piracy. In order to tackle the causes of piracy, economic and political stability in Somalia would have to be achieved. There is ample work on conflict and development, see e.g. World Bank (2003) or World Bank (2010), and it is clear that there are no panaceas. Collier et al. (2004) show that low per-capita income and high inequality lengthen civil war, backing the case for economic development. In contrast, the duration of civil war and conflict is shortened by declines in prices of the commodities a country exports and by external military intervention according to Collier et al. (2004). Since the Somali pirates are not to date a group involved in political conflict there, their high incomes need not actually fuel the conflict in Somalia. Bigombe

et al. (2000), Collier and Hoeffler (2004) and Chauvet and Collier (2005) further discuss strategies for (post-)conflict governments and the international community to reduce the risk of conflict and achieve economic development. For instance, Chauvet and Collier (2005) argue that during conflict aid for post-primary education can be useful.

One additional concern with piracy is that while it undermines state institutions and may fuel conflict, it contributes to people's incomes and thereby to economic development. Questions of tackling piracy and achieving development in Somalia are thus intimately linked. Tentative conclusions may be drawn from the experience of countries where illegal drugs play a major role for individual incomes. Angrist and Kugler (2005) show that in Colombia, increases in coca production generated economic gains in rural areas. Meanwhile economic spillovers were small, and conflict was indeed fueled. Byrd (2008) emphasizes that in Afghanistan the opium economy has created a Dutch disease problem with overall labor incomes rising but productivity remaining low. A similar problem is to be expected with Somali piracy. Another similarity is that while actions against the opium economy were often effective locally, they encouraged shifts in productions sites. While attacks by Somali pirates in the Gulf of Aden have gone down in 2009, a number of attacks have occurred far off the Somali coast.[1] Byrd (2008) strongly suggests mainstreaming counter-narcotics and development in Afghanistan and taking adverse side effects of policies into account, focusing prosecution on the larger drug traffickers and their sponsors, encouraging those individuals most likely to have alternatives to move away from drug production, and supporting sensible long-run rural development.

Tackling piracy in the short or medium term can involve making piracy more costly or making alternative occupations more attractive. We first investigate a reduction of fishing activities. The second measure is the (military or judicial) prosecution of pirates. Third, we consider an increase in the number of admitted immigrants from the developing country. The judicial or military prosecution of pirates makes piracy a more costly occupation. Reducing fish production and increasing immigration make alternative occupations more attractive.

The western world's response to maritime piracy in the Gulf of Aden has been mainly military, see UN Security Council Resolution 1816 (2008) and European Union (2010), with recently intensified efforts to overcome problems of prosecuting pirates in court, see UN Security Council Resolution 1897 (2009). Kontorovich (2010) analyzes these judicial problems. He claims that while international law has required states to fight maritime piracy for

[1] ICC International Maritime Bureau (2009)

a long time, "international legal norms that limit state authority and provide greater protections for individuals"(Kontorovich 2010, p.6) have made prosecution costly enough to prevent it in many cases. Leeson (2009b) argues that the elimination of large-scale maritime piracy in the 18th century was mainly due to legal changes allowing the prosecution of pirates in the British colonies, but that in dealing with modern pirates it should be taken into account that pirates have always developed rational strategies for circumventing the law. We take a look at fishery policies since illegal fishing by industrialized countries' trawlers off the Somali coast has been documented[2] and is often used by pirates as an excuse for charging "fines". Migration is important in the context of Somalia, as the country has been characterized by mass emigration since the collapse of its government in 1991. Furthermore, remittances seem to play an important role in Somalia's economy, as Munzele Maimbo (2006) shows. However, we do not explicitly model remittances.

While historians and sociologists have long dealt with questions relating to maritime piracy (see e.g. the University of Amsterdam's program *Piracy and Robbery in the Asian Seas*), research in Economics on the subject is scarcer. A notable exception is Peter Leeson, who has written extensively on the functioning of pirate societies, see e.g. Leeson (2007), Leeson (2009a) and Leeson (2009b). Two additional contributions to the economics of maritime piracy have been published relatively recently. In an empirical investigation Mejia Jr. et al. (2009) find that the probability of being attacked by pirates between 1996 and 2005 significantly depended on the type of vessel, with vessels with a low freeboard and vessels under Asian flag being attacked more frequently.[3] Anderson and Marcouiller (2005) show in a theoretical model how endogenous piracy can act as a barrier to trade.

We model the decision to become a pirate in section 2 and analyze the effectiveness and feasibility of different policies in section 3. Section 4 concludes.

2 Becoming a Pirate

We consider a static setting with two countries, an industrialized country (IC) and a developing country (DC). Both countries engage in the production of a consumption good (fish) using labor as an input:

$$F = \left(\frac{AL_F}{AL_F + L_F^*}\right)^{\beta} \quad \text{and} \quad F^* = \left(\frac{L_F^*}{AL_F + L_F^*}\right)^{\beta}, \qquad \beta < 1 \,.$$

[2] see e.g. Economist (2008)

[3] According to ICC International Maritime Bureau (2008) the highest number of attacks in the years 2003 until 2006 occurred in Indonesia, Malaysia and the Malacca Straits.

The asterisk denotes the developing country's variables. We abstract from capital as a production factor for simplicity. The production of fish is subject to diminishing returns to scale, since fish is an exhaustible good. Furthermore, production decreases with the other country's labor input. The intuition is that both countries fish from the same stock of fish - even though in reality property rights are clearly defined, a country like Somalia is not capable of enforcing them. We normalize the developing country's labor productivity to 1, while we allow the industrialized country's labor productivity A to be larger or equal to 1. N and N^* are the sizes of the native populations, and individuals exogenously supply one unit of labor, such that in the absence of piracy $L_F = N$ and $L_F^* = N^*$. We assume the industrialized country to be at least as large as the developing country, that is $N \geq N^*$. Per capita consumption is given by

$$c = \frac{F}{N} \quad \text{and} \quad c^* = \frac{F^*}{N^*} \, .$$

Next, we add the option of becoming a pirate to the model. The developing country's citizens may either engage in fish production or in piracy. We then have $N^* = L_F^* + L_P^*$. We define piracy "production" Φ as the expropriation of some of the industrialized country's consumption good. We believe that this captures the observed extortion of ransoms by Somali pirates in a tractable way, without having to abandon the assumption of a single consumption good. Φ is increasing in the number of pirates L_P^*, but it is independent from the industrialized country's fish production. The idea is that the piracy sector is small compared to world fish production and can be increased without fish production increasing.[4]

$$\Phi = \varphi(L_P^*)^\alpha \quad < \quad F \, , \qquad \alpha \leq 1 \, .$$

The parameter φ denotes the pirates' productivity in expropriating. Note that, as the industrialized country's productivity in fish production increases, fishing becomes less attractive for a developing country native, whereas the attractivity of piracy is independent from F, since Φ is always smaller than F.

Per capita consumption from fishing and piracy is given by

$$c = \frac{F - \Phi}{N} \, , \quad c_F^* = \frac{F^*}{L_F^*} \quad \text{and} \quad c_P^* = \frac{\Phi}{L_P^*}$$

[4]If piracy increased in the industrialized country's production, the migration of workers to the industrialized country would make piracy more profitable for the remaining workers in the developing country.

respectively. We assume utility to be linear in consumption. Furthermore, becoming a pirate involves a disutility d. The intuition is that stealing is considered immoral. The parameter d may also incorporate the adverse legal consequences of becoming a pirate. Clearly, in a "failed state" these legal consequences can be expected to be relatively unimportant.

The developing country's natives decide whether to work as fishermen or as pirates. Setting $c_P^* - d = c_F^*$ yields the following implicit function for L_P^*:

$$\left(\frac{N^* - L_P^*}{AN + N^* - L_P^*}\right)^{\beta} \frac{1}{N^* - L_P^*} - \varphi(L_P^*)^{\alpha-1} + d = 0 \; . \tag{1}$$

One cause of the high number of Somali pirates is the absence of a functioning state in Somalia. When individuals do not expect to be held responsible for committing acts of piracy, the disutility attached to being a pirate certainly decreases. Another cause is poverty or a lack of alternative occupations. As described above, large-scale fishing by industrialized countries may have reduced incomes of Somali fishermen and thereby have made piracy a more attractive option. Consequently, the number of pirates in (1) can be shown to increase with A and decrease with d. Furthermore, the number of pirates increases with the productivity φ achieved in robbery.

Our setting is static; however, productivity changes can be interpreted in a chronological way, as figure 1 shows. As long as both countries have a low

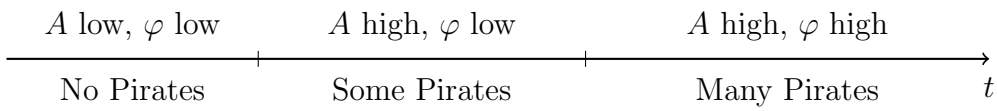


Figure 1: Chronological Model Interpretation

productivity in fish production, it is worthwhile for natives of both countries to engage in fishing. Now, if the industrialized country becomes a lot more productive in fishing, the developing country's fishermen's production drops and it may pay for them to become pirates instead. This may not bother the industrialized country, as long as the pirates' productivity is low. Imagine the pirates themselves becoming more productive over time, as seems to have happened in Somalia. Letting the pirates rob them might then not be optimal for the industrialized country's natives anymore. The same argument holds concerning lawlessness in Somalia. Lawlessness may not bother the industrial country as long as pirates are relatively unproductive.

3 Piracy Control

A surge in piracy has two effects on the industrialized country's per capita consumption. First, it lowers competition in the fishing sector. This effect is positive but small if the industrialized country is much larger and much more productive in fishing than the developing country. Second, it reduces the share of the fishing sector's output which actually reaches the industrialized country's natives. The change in per capita consumption when the number of pirates increases marginally is given by:

$$\frac{dc}{dL_P^*} = \frac{1}{N}\left[\frac{\beta F}{AN + N^* - L_P^*} - \frac{\alpha}{L_P^*}\Phi\right] . \tag{2}$$

The parameters α, φ and β also influence the size of the two effects. The larger the marginal productivity of pirates and the smaller the marginal productivity of fishermen, the more prominent becomes the negative effect. We assume the conditions for $dc/dL_P^* < 0$ to be fulfilled. Otherwise, there is no need for the industrialized country to consider tackling piracy.

We now investigate how different approaches to fighting piracy affect the industrialized country's per capita consumption. First, we consider the industrialized country's option of reducing its own fish production. Second, we investigate the impact of expenditures on the military (or judicial) prosecution of pirates, which we model as reducing the productivity of pirates (or increasing the disutility related to piracy). Third, we integrate endogenous immigration policy into our model, and analyze the relationship between emigration from the developing country and the number of pirates there.

3.1 Reducing Fish Production

If the industrialized country uses less effective methods for extracting the stock of fish, the consumption level which the developing country's natives achieve by fishing increases, making fishing more attractive relative to piracy. Obviously, the industrialized country's output drops when less effective fishing methods are employed. If the pirates' productivity has risen in time, going back to fishing less of the exhaustible stock of fish will not establish the previous equilibrium. In principle, per capita consumption in the industrialized country may still increase. The respective derivative is

$$\frac{dc}{dA} = \frac{1}{N}\left\{\frac{\beta F\left(N^* - L_*\right)}{A\left(AN + N^* - L_P^*\right)} + \left[\frac{\beta F}{AN + N^* - L_P^*} - \frac{\alpha}{L_P^*}\Phi\right]\frac{dL_P^*}{dA}\right\} , \tag{3}$$

where

$$\frac{dL_P^*}{dA} = \frac{\frac{\beta F^*}{N^*-L_P^*} \cdot \frac{N}{AN+N^*-L_P^*}}{\frac{F^*}{(N^*-L_P^*)^2} \cdot \left[1-\beta\frac{AN}{AN+N^*-L_P^*}\right] + (1-\alpha)\varphi\left(L_P^*\right)^{\alpha-2}} \quad > 0$$

can be derived using the implicit function theorem. The first term in equation (3) is the positive effect of an *increase* in the productivity A on fishing production. With $dL_P^*/dA > 0$, the second effect is the increase in industrialized country fishing output due to a lower number of developing country fishermen, and the third effect is the increase in the output stolen by pirates due to a higher number of pirates. We know from equation (2) that the sum of the last two terms is negative. Reducing fishing productivity can thus only increase per capita consumption in the industrialized country if the resulting drop in the number of pirates is very large. Note that it does increase per capita consumption in the developing country.

Figure 2 illustrates a numerical example. For a population size of $N = 10$ in the industrialized country and $N^* = 1$ in the developing country, for productivity parameters $\alpha = 0.9$ and $\beta = 0.7$, such that decreasing returns to scale are more severe in fishing than in piracy, and for $\varphi = 0.02$ and $d = 0.01$, increases in fishing productivity A only increase per capita consumption in the industrialized country up to a level of A just below 30. On the one hand, very effective methods of fishing only lead to small increases in the number of catch, due to the exhaustible stock of fish. On the other hand, ever more developing country natives turn to piracy as the stock of fish diminishes.

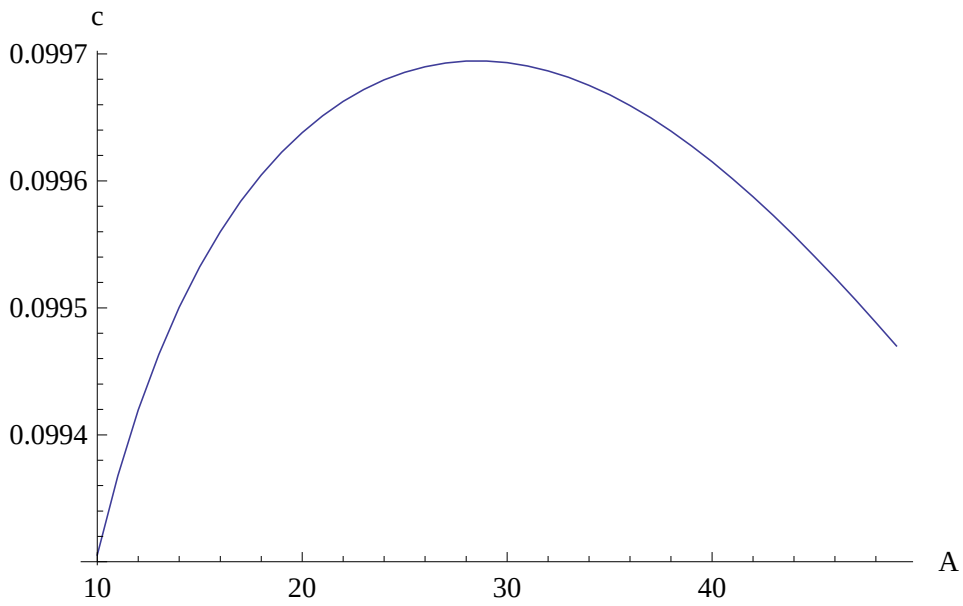
3.2 Military or Judicial Prosecution of Pirates

Military expenditures E can be modeled in two ways, either in terms of output or in terms of labor. We choose the second option. This means that part of the industrialized country's labor force is not employed in production but in fighting pirates. Fishing production is then given by

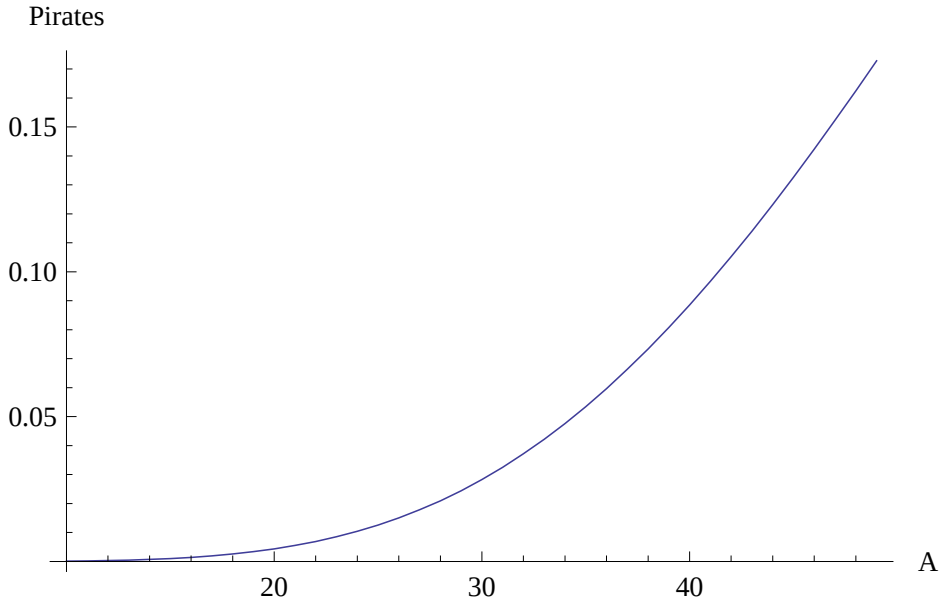
$$F|_E = \left[\frac{A\left(N-E\right)}{A\left(N-E\right)+N^*-L_P^*}\right]^\beta \quad \text{and} \quad F^*|_E = \left[\frac{N^*-L_P^*}{A\left(N-E\right)+N^*-L_P^*}\right]^\beta .$$

Furthermore, we assume $d\varphi/dE < 0$, although we do not quantify this change for now. An increase in military expenditures or efforts then has four effects on per capita consumption:

$$\frac{dc_E}{dE} = -\frac{1}{N}\left\{\frac{\beta F|_E\left[\left(N^*-L_P^*\right)-\left(N-E\right)\frac{dL_P^*}{dE}\right]}{\left(N-E\right)\left[A\left(N-E\right)+N^*-L_P^*\right]} + \frac{d\varphi}{dE}\left(L_P^*\right)^\alpha + \frac{\alpha}{L_P^*}\Phi\frac{dL_P^*}{dE}\right\}, \tag{4}$$



(a) Per capita consumption in the industrialized country



(b) Extent of piracy

Figure 2: Effects of fishing productivity

with

$$\frac{dL_P^*}{dE} = -\frac{\frac{\beta F^*|_E}{(N^*-L_P^*)^2} \cdot \frac{A(N^*-L_P^*)}{A(N-E)+N^*-L_P^*} - \frac{d\varphi}{dE}(L_P^*)^{\alpha-1}}{\frac{F^*|_E}{\left(N^*-L_P^*\right)^2}\left[1-\beta\frac{A(N-E)}{A(N-E)+N^*-L_P^*}\right] + (1-\alpha)\varphi(L_P^*)^{\alpha-2}} < 0 \; .$$

Fish production in the industrialized country drops due to the lower number of natives employed in fishing and to the higher number of developing country fishermen. Nevertheless, per capita consumption may increase because the pirates' productivity is lower and because there are less pirates. An additional concern with respect to the military persecution of pirates is that, while it makes piracy less attractive, it does not raise the consumption level of the developing country's natives.

In order to illustrate the effect of deploying some workers in the military on per capita consumption, we have to assume a functional form for the pirates' productivity parameter φ. With

$$\varphi(E) = a - \frac{a}{N^2}E^2$$

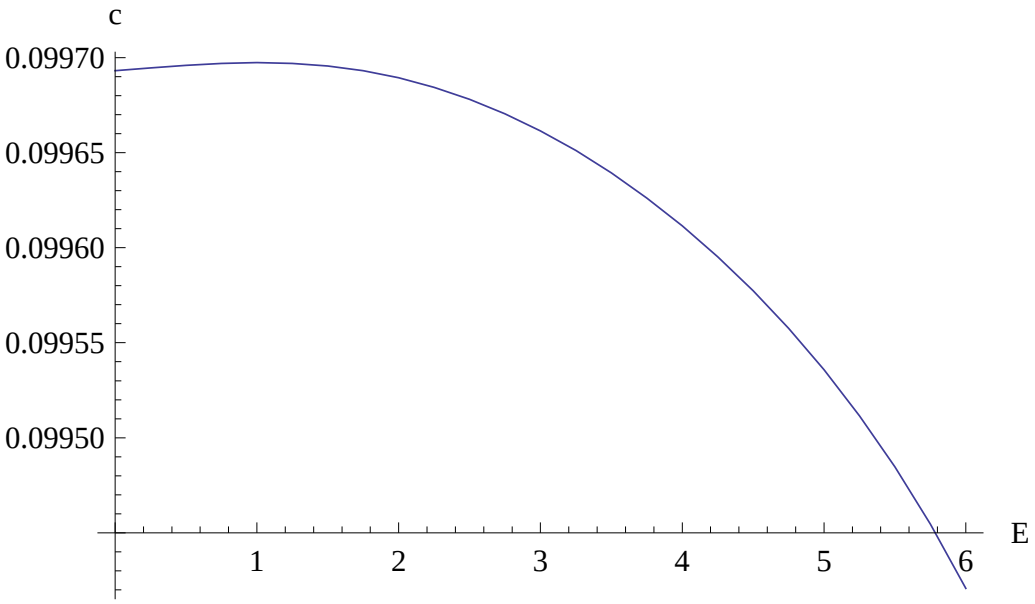
productivity is equal to a in the absence of military expenditure and zero when all industrialized country natives are employed in the military. In figure 3 the parameter values are the same as the ones used for figure 2, a is set to 0.02 and A to 30. For these parameter values, the benefits of military expenditures initially exceed their costs in terms of per capita consumption.

The judicial prosecution of pirates is also costly for the industrialized country. As in the case of military expenditures, expenditures on legally prosecuting pirates can be modeled in terms of output or of labor. The only difference is that instead of the pirates' productivity the disutility related to becoming a pirate is directly affected. The term $(d\varphi/dE)\,(L_P^*)^{\alpha}$ in equation (4) then vanishes and the derivative of the number of pirates with respect to expenditures becomes

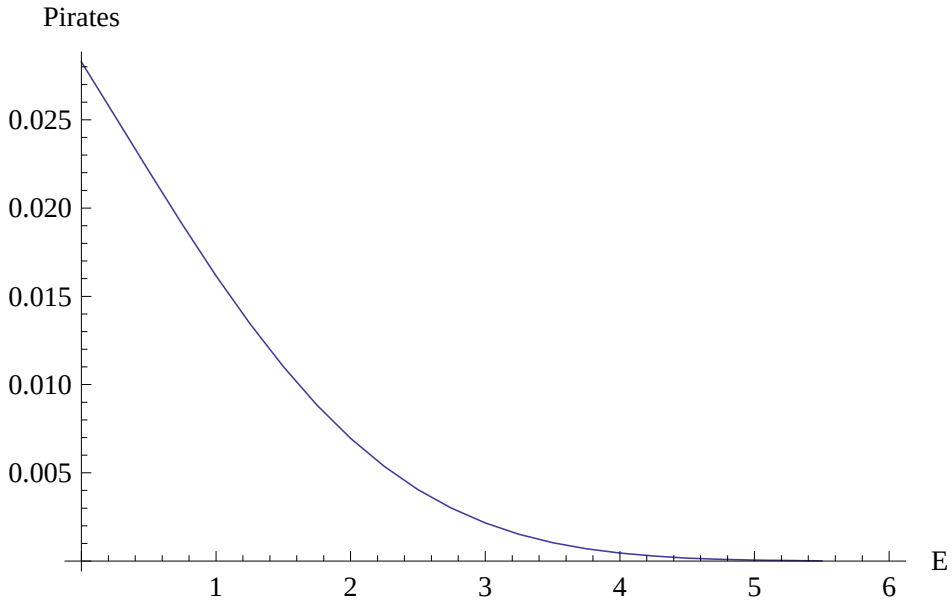
$$\frac{dL_P^*}{dE} = -\frac{\frac{\beta F^*|_E}{(N^*-L_P^*)^2} \cdot \frac{A(N^*-L_P^*)}{A(N-E)+N^*-L_P^*} + \frac{dd}{dE}}{\frac{F^*|_E}{\left(N^*-L_P^*\right)^2}\left[1-\beta\frac{A(N-E)}{A(N-E)+N^*-L_P^*}\right] + (1-\alpha)\varphi(L_P^*)^{\alpha-2}} < 0 \; .$$

An upper bound to what the judicial persecution of pirates can achieve can be calculated by assuming that maximum judicial expenditures induce an infinite disutility d. The disutility parameter can then be expressed as follows:

$$d(E) = b + \frac{E}{N-E} \; .$$

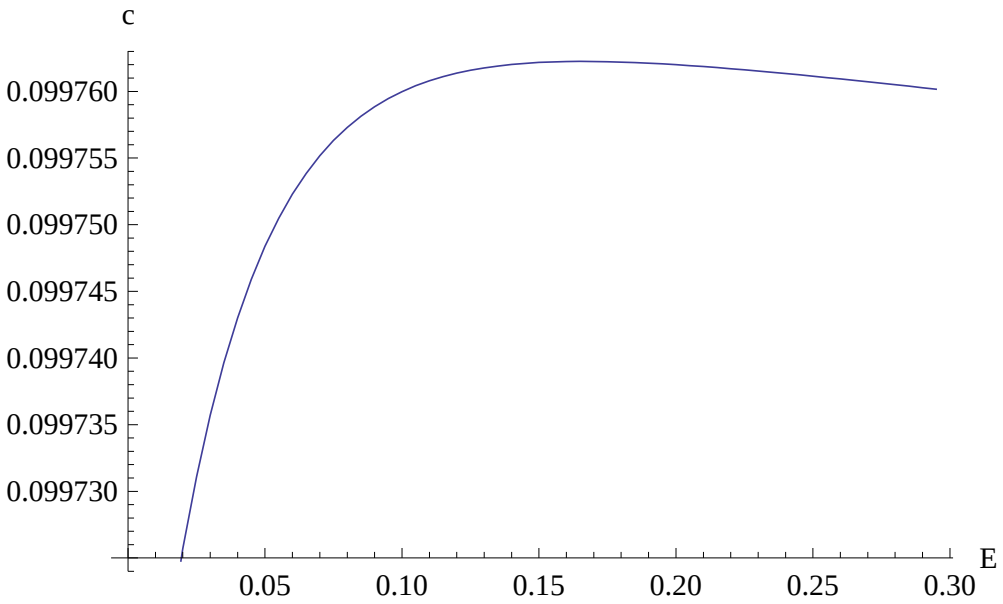


(a) Per capita consumption in the industrialized country

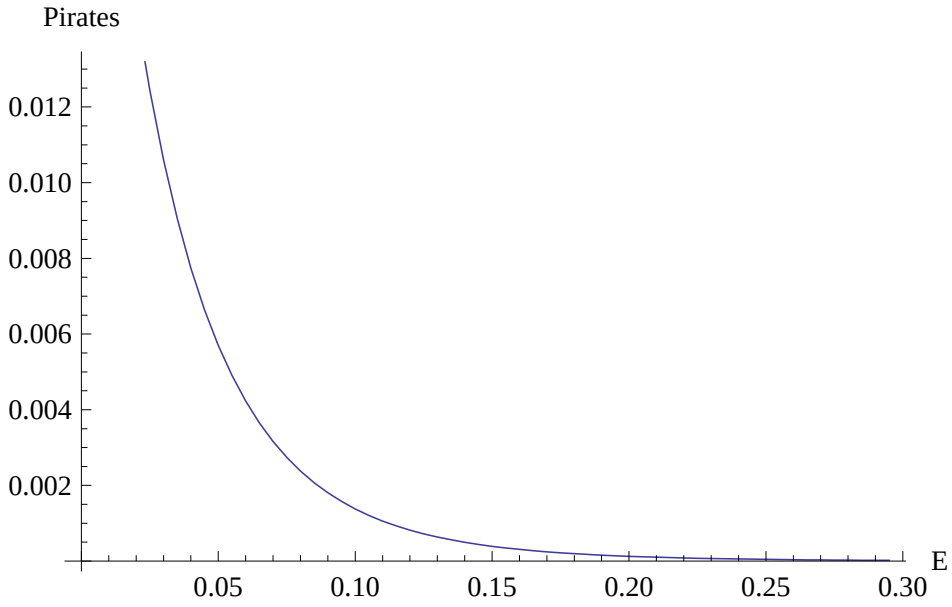


(b) Extent of piracy

Figure 3: Effects of of military expenditures



(a) Per capita consumption in the industrialized country



(b) Extent of piracy

Figure 4: Effects of of judicial expenditures

Again, for illustration we use the same parameter values as before, including $b = 0.01$ and $A = 30$. Under the assumption that piracy control expenditures reduce the disutility related to becoming a pirate instead of the pirates' productivity, the number of pirates seems to decline much more rapidly. However, this rapid decline is contingent on the assumed functional form for $d(E)$.

3.3 Immigration Policy

We start this subsection by considering migration motives and immigration policy in a setting without piracy. Immigrants are assumed to be less productive than natives when employed in the industrialized country's fish production and therefore also to have a lower consumption level than natives. For simplicity, we assume that the immigrants' productivity is just equal to 1, the same as their productivity in the home country. The developing country's young have an incentive to migrate, for any $A > 1$ or $N > N^*$, until $c^* = c_M$, where c_M is the consumption level of the immigrants. Fish production is now given by

$$F|_M = \left[\frac{AN + M}{A + N^*}\right]^{\beta} \quad \text{and} \quad F^*|_M = \left[\frac{N^* - M}{AN + N^*}\right]^{\beta} ,$$

and the natives' and immigrants' consumption levels in the industrialized country are given by

$$c_N = \frac{AN \cdot F|_M}{AN + M} \quad \text{and} \quad c_M = \frac{M \cdot F|_M}{AN + M} ,$$

respectively, while consumption in the developing country is given by

$$c^* = \frac{F^*|_M}{N^* - M} .$$

In the absence of immigration constraints, the level of migration equalizing consumption c^* and c_M is $M = (AN - N^*)/2$. Even though production in the industrialized country clearly increases with immigration, per capita consumption of the natives decreases since the number of workers increases by more:

$$\frac{dc_N}{dM} = -(1 - \beta)\frac{AF|_M}{(AN + M)^2} \qquad < 0 . \tag{5}$$

In the presence of piracy, the industrialized country's natives have an additional motive for admitting immigrants, as long as $dL_P^*/dM < 0$. Using

the implicit function theorem, we can derive

$$\frac{dL_P^*}{dM} = -\frac{(1-\beta)\cdot\frac{F^*|_M}{(N^*-M-L_P^*)^2}}{\frac{F^*|_M}{(N^*-M-L_P^*)^2}\cdot\left[1-\beta\cdot\frac{A\cdot N+M}{A\cdot N+N^*-L_P^*}\right]+(1-\alpha)\varphi(L_P^*)^{\alpha-2}} \quad <0\ .$$

Piracy decreases because the fishing output now has to be shared among a lower number of workers, even though the fishing output itself also decreases. The change in the industrialized country's natives' per capita consumption is

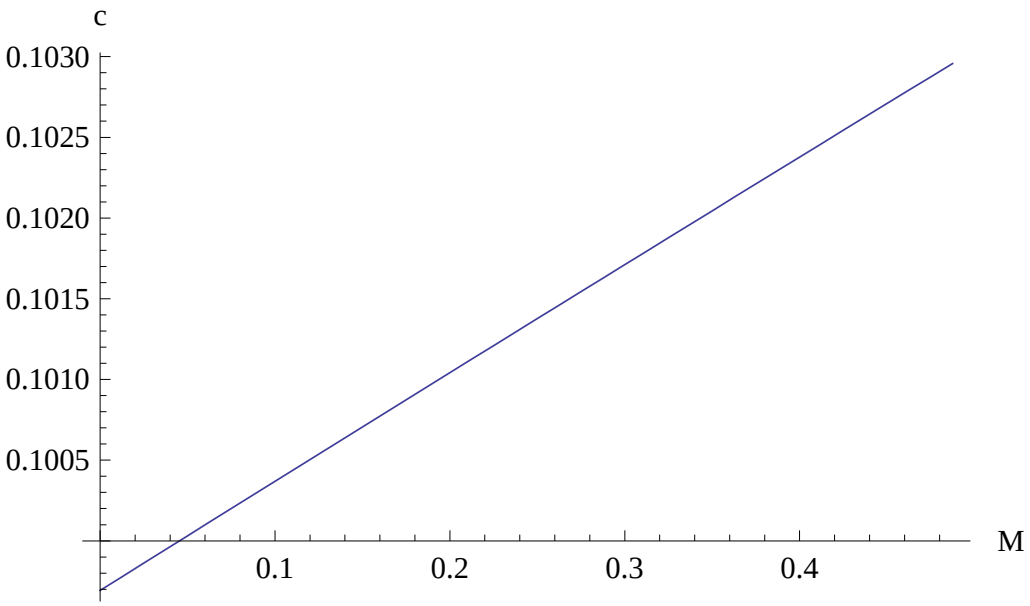
$$\begin{aligned}\frac{dc_N}{dM} =& -\frac{A\left(F|_M-\Phi\right)}{\left(AN+M\right)^2} \\ &+\frac{\beta AF|_M}{\left(AN+M\right)^2}\left[1+\frac{\left(AN+M\right)\frac{dL_P^*}{dM}}{AN+N^*-L_P^*}\right] \qquad (6)\\ &-\frac{A}{AN+M}\cdot\frac{\alpha}{L_P^*}\cdot\Phi\cdot\frac{dL_P^*}{dM} \\ =&\frac{A}{AN+M}\left\{\frac{-\left(1-\beta\right)F|_M+\Phi}{AN+M}+\left[\frac{\beta F}{AN+N^*-L_P^*}-\frac{\alpha}{L_P^*}\Phi\right]\frac{dL_P^*}{dM}\right\}\ . \qquad (7)\end{aligned}$$

We can distinguish four effects. As in the setting without piracy, output has to be shared among a higher number of people. This can be seen from the first line of (6). Output increases due to the higher number of workers but competition in fishing also increases, as can be seen from the second line. Finally, "net" output increases because there are less pirates. From equation (7) it follows that immigration is more likely to increase per capita consumption, the higher piracy output Φ and the larger the drop in the number of pirates due to emigration from the developing country.

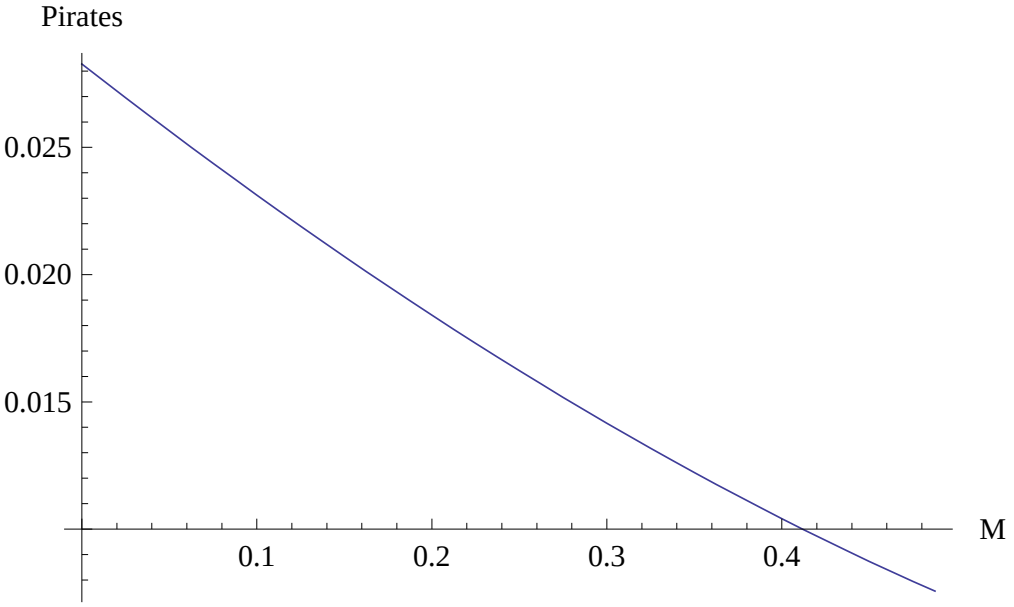
For our benchmark parameter values, admitting more immigrants unambiguously increases per capita consumption in the industrialized country, see figure 5.

3.4 Comparison

The consumption levels resulting from the different policy choices are not directly comparable. In figures 3, 4 and 5 the industrialized country's fishing productivity is set to its optimal level. Therefore, the intercept on the c-axis corresponds to maximum per capita consumption in figure 2. Furthermore, the depicted levels of per capita consumption c and piracy L_P^* are highly sensitive to the assumptions concerning $\varphi(E)$ and $d(E)$.



(a) Per capita consumption in the industrialized country



(b) Extent of piracy

Figure 5: Effects of increasing immigration

4 Conclusion

In this paper we model piracy as the result of an increase in fishing by a rich country, reducing the poor country's fishermen's consumption levels and of a decrease in (legal) costs related to piracy. In order to tackle the "Gulf of Aden Buccaneers", rich countries have the option to make piracy more costly (e.g. by persecuting pirates) or to make alternative occupations more attractive. This paper compares the impact of several short or medium-term measures on piracy and on well-being in the industrialized country, measured by per capita consumption. An evaluation of the combination of different measures remains to be done. Furthermore, it would be worthwhile to explicitly take into account additional sectors in the economy, sectors which may grow due to remittances or human capital. Furthermore, a two-country model is too simple to capture several additional issues. For example, counter-piracy measures are a public good and are thus likely to be undersupplied in an international context. Additionally, increasing the number of admitted immigrants from Somalia to industrialized countries as a means to counter maritime piracy may have perverse effects on other conflict countries.

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