

Micro-economic Efficiencies and Macro-economic Inefficiencies: Theoretical Reflections on Renewable Resource Policies in Very Poor Countries

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Abstract. Economists in developed countries having specific institutional and macroeconomic conditions have been the major contributors to fisheries economics theory and policy. Whereas the theory and the policies may be appropriate in certain circumstances for developing countries, it is not necessarily true that the two major recommendations of fisheries theory, capacity control and rent extraction and concentration, are desirable policies in poor and disorganized countries. We use a standard Keynesian macro-model, coupled with some simple assumptions from fisheries economics to show that leakage outside the country and subsequent economic growth slowdown might be incited by policies that encourage industrial concentration of rents, especially if there is subsequent capital flight. In these cases, policies which promote employment in parts of the fisheries sector that are tied more closely to the local economy may have a proportionally large positive impact on the growth of the economy.

Keywords : macroeconomics, developing countries, rent dissipation, growth, fisheries.

1. INTRODUCTION

Most modern fisheries economists acknowledge that the predictions of the earlier fisheries economists were essentially correct. The property problem in many fisheries has led to cases of excess capacity. This excess capacity stresses the productive capacity of the natural stocks, with a number of environmental consequences. These economists proposed policies aimed at reducing the excess capacity in the fishery. An additional policy that is also frequently discussed is the use of rent extraction. The reasoning goes that once limited licensing and individual quotas are put in place, it often becomes necessary for the government to extract rents from the fishery through competitive systems of license attribution. The holder of the permit, the fisherman, is supposed to retain a normal profit. The resource rent is taken by the State to help pay for management services, and hopefully to pay for other government investments as well. This reasoning has caught the attention of development economists as a possible way of financing the re-structuring of countries which have extractive industries in natural resources, especially fisheries.

There are a number of theoretical and practical questions that have arisen from these propositions. Bishop (1973) asked how important the inefficiency of open access really was compared to the costs of correcting it. Anderson and Hill (1983), Wilson (1982) as well as Coase (1970) all asked similar types of questions about the real efficiencies of simulating a sole owner solution, given the incentives of residual claimants and the ability

of public managers to overcome transactions costs. More recently, institutional economists have asked if commons management is really as inefficient as we suppose (Feeny et al 1996), whereas more classical economists have become opposed to the policies which are currently under discussion for the fisheries, especially individual quotas or ITQs (Copes, 1986). As for rent capture, most public managers have come to the realization that it is easier said than done. Grafton (1995a, 1995b, and 1996) has written extensively on rent capture and taxation in rights based fisheries. The possibility of rent capture and how to do it in different contexts has raised a number of practical questions. For example, to what end will the collected rents be used? How much productive capacity will be displaced, and what are the costs of retooling this productive capacity compared to the rents captured? Is the "firewall" between the collected rents and rent seekers strong enough to withstand a sustained attack by rent-seekers? Other questions arise as to the ability of even the most diligent of public managers to establish the correct level of rent extraction. Some economists working in developing countries take it as almost a given, while others are not so sure (Wilson, 1998). This uncertainty is present even among the strongest proponents of ITQs. In 1979, Maloney and Pearse discussed rent extraction as a feature of their new proposed policy. Later, Pearse (1991) as well as Pearse and Walters (1992), in reviewing the first ten years of ITQs in practice, are less sanguine. These views are also reflected in the work of Squires et al (1995), as well as Boyd and Dewees (1991). All, save for the most optimistic, have become more cautious about recommending different forms of privatization and rent extraction, even though the control of excess capacity for them is still important. These are just some of the

questions about rent extraction policies in industrialized countries with functioning income and capital gains tax systems, and where perceived capacity inefficiencies could be handled through fairly advanced regulatory systems.

However, these particular fisheries policies can have debatable results in developing countries as well. These countries share a number of conditions that developed countries may not have. Fisheries are relatively more important in many poorer countries. The fact that fisheries are more important makes the impacts of fisheries policies, and mistakes in fisheries policies, more important. These same countries usually have large numbers of small entrepreneurs engaged in commercial activities as well as other extra-market economic activities within their own communities, not the least of which is subsistence. Many poorer countries struggle to keep a balance between providing an attractive environment for foreign investment and maintaining sufficient control over the tax structure and the public finances, in order to obtain public revenues. They also, like many developed countries, fight a continuous battle against corruption and rent seeking by public servants. However, unlike developed countries, there are often deep-rooted institutional and economic reasons for corruption. Modern feudalism in a bureaucratic setting, the felt need by western trained nationals to be compensated at world standards for their services, the need for a retirement pension, and the need to obtain campaign funds for political advancement are all strong incentives for rent seeking which exist in many developing countries. These same incentives may not exist to as great a degree in developed nations. These economic incentives for rent seeking almost guarantee that without significant amounts of investment and retraining in the actual workings of a given ministry, policies having to do with the concentration of rent will be rapidly subverted by the very agents charged with the stewardship of the rents.

This paper explains why the cornerstone recommendations of fisheries economists, capacity reduction and rent extraction, may not be efficient policies for extremely poor countries. We will motivate this proposition in two ways: by resort to a hybrid between a standard bio-economic model and the classical Keynesian model, and also by grounding the theoretical discussion with allusions to actual cases in developing countries, with particular reference to Madagascar. In Section 2, the basic propositions are laid out graphically.

Section 3 presents the model assuming that resource rents can be concentrated and captured through policies seeking to control capacity. Those who benefit from these rents then dissipate them out of the country through directly unproductive imports or offshore investments. In this

case we show that this leakage out of the country can in some instances lead to slower growth in the rest of the economy than if the fishery was managed in open access, where rents were allowed to dissipate into the economy.

This observation raises a question about the pertinence of the rent dissipation argument that appears in fisheries economics literature. The preoccupation with rent dissipation is perhaps most justified in the case where the economy in question is perfectly competitive and highly porous to the outside world, so that rent is dissipated out of the country in question. If resource rents are being dissipated into an economy with imperfections or "rent traps," this dissipation can be translated into investment and a reduction in the unemployment rate, especially under the Keynesian assumptions of the aggregate supply curve. Secondly, over-capacity arguments, and the need to reduce over-capacity, may be irrelevant when applied to poorer countries. Some poor countries like Haiti experience local over-exploitation of resources, but on the other hand, the fishery sector is still severely limited by their technologies. While we may see local over-exploitation effects, this may not mean that their resource bases are generally damaged. It may mean that the country is so impoverished that there are no rents left in the economy to make investments, in order to use marine or other resources more intensively. The rents have been literally drained out of the country.

Other countries like Madagascar probably do need to control their capacity in some cases like the shrimp fishery, but it is mainly to bring their productive capacity in line with ecosystem services. Capacity reduction from a macroeconomic standpoint may also have benefits, but only if the marginal productivity of the inputs is truly higher elsewhere in the economy. However, this result has to take account of the labor force. Also, an analysis of the multiplier effects may suggest that the so-called over-capacity in the fishery can have a greater positive effect on national income than the net effect of taxation and government spending, if the economy is highly porous.

In Section 4, we look at the results of Section 3 more closely, asking if there might not be institutional reasons for seeing fisheries policies that engender different types of techniques and industry structures. Specifically, we look at the economic growth characteristics of an industrial fishing sector where rents are concentrated, and the marginal propensity to consume imports from these rents is elevated. We compare this industrial structure to an open access traditional industrial structure with higher employment potential.

In the last section of the paper, the classical Keynesian assumption is relaxed, and price levels are allowed to change. In this case, the impact of autonomous changes in employment in the fisheries sector will depend upon

the form of the aggregate supply curve, and the impact of different industrial structures in the fishery on aggregate demand. Capacity reduction and rent capture in the fishery may make sense when current country production is close to potential or maximum output, where the supply curve is asymptotic to an output Y_{\max} . During periods of boom in the economic cycle, when the opportunity costs to labor tend to be acute, fisheries economists might encourage adoption of capacity control policies. However, at the same time, autonomous injections of rents into the economy through government spending will be dissipated away through inflationary effects. In the unlikely case where potential GNP is approached in the short term, the comparative benefits of traditional or industrial structures on the economy would be therefore reversed.

2. A GRAPHICAL DESCRIPTION

Refer to **Appendix Figure A-1**. We will be dealing with models of two sectors; Sector 1, the fisheries sector with a standard Schaefer model, and Sector 2, which is the rest of the economy. In Sector 1, the variable N_1 is interpreted conjointly as effort and employment. It is exogenous to the model, and based upon the fisheries policies in place. We assume two possible policies (or groups of policies) leading to two possible outcomes. On the one hand we have policies which result in a simulation of the sole owner (N_1^* , Y_1^*) solution. In this case, public managers and the members of the industry divide up the rents and then remove most of this rent from the territory through imports that are directly unproductive, or by simply moving the rent off-shore. Alternatively, there is the open access solution (N_1^{**} , Y_1^{**}), where the rents are dissipated into the local economy. For simplicity, we will assume that the outputs of the fishery sector are exported entirely.

The fact that employment and output in Sector 1 can change will have an impact on the macroeconomics of Sector 2 (**Figure A-1b**). This will have an impact on the demand characteristics in the economy. As consumption, investment, public spending, and net exports change, projected expenditures and therefore aggregate demand in Sector 2 change as well. If the short-run supply curve of Sector 2 is flat (the Keynesian assumption), aggregate demand moves out with no change in the price level, P . If the short-run supply is not flat, but is asymptotic to some maximum short-run output, then there will be negative feed-back to Sector 1 (and 2) through that part of W which is affected by P and the part of R , the rents, which will also be affected by P . Employment in Sector 2, N_2 , is endogenously determined by the output in Sectors 1 and 2 through the employment function. The point of the paper is that if different policies are thought to change N_1 , and therefore other macro-economic variables in the economy, then we might ask if there is not a third possible

equilibrium (call it N_1^{***} , Y_1^{***}) which would be desirable from a macro-economic standpoint. We might be interested in this, not particularly to promote the equilibrium, but rather to compare it with other equilibriums resulting from different policies of capacity control. We might also be interested in such modeling exercises in order to review the possible mechanics of economic growth, and the assumptions we have about these mechanics.

Governments as well as major lenders like the World Bank rely heavily on the positive effects of both fiscal and monetary policy reforms for economies. However, there are a number of reasons why fiscal policies in poorer countries fail to achieve their objectives. First, countries like Madagascar and Haiti may have suffered severe brain drain effects, gutting their public and private sectors of much of their productive work force. In addition, widespread rent seeking by those who remain may redirect tax dollars into the economy as consumption and investment. However, these forms of corruption may also add to the porosity of the country in three ways. First, savings abroad represent a short-run leak in the economy that often turns into a long-term loss of rents. Second, the marginal propensity to import among rent-seekers may be comparatively higher than for the rest of the population. Third, governments may attract foreign investors who are willing to share rents in exchange for other considerations: duty free industrial zones, forgiveness or reduced rates for income and capital gains taxes, and other special concessions for resource use. However, poorer countries are more susceptible to capital flight by not being able to control transfer pricing and unauthorized exportations. Government officials may actually want a privileged relationship with certain foreign investors. These things make straightforward fiscal policies difficult to put in place. On the other hand, because of the growth advantages of a well-functioning public sector, lender institutions are often compelled to try and follow this model despite the dangers. Fisheries policy as proposed by fisheries management specialists is especially attractive, because much of the literature on fisheries provides compelling arguments for reducing excess capacity and capturing rents in the fishery. Mathiasson (1998), for example, draws a direct link between the size of the fishing sector and the impoverishment of the public sector. However, if the root causes of the leaks are not addressed at the macro-level, the policies proposed by fisheries economists may accelerate dissipation of rents out of the country. Section 3 of the paper demonstrates this effect.

3. THE BASIC MODEL

Most fisheries analyses are presented as partial equilibrium concepts, and assume the approximate

efficiency of management (Hanesson, 1993). Sometimes this simple assumption is further developed by resort to models that look at multi-objective optimisation (Pascoe et al, 1997). However, in many cases the assumption of efficient management may not apply. Many poorer countries have arrived at something like “economically efficient” policies in some cases, but it may not be because there were any clear efficiency objectives. Madagascar, in particular, has experimented with various types of sole owner and restricted entry management schemes. However, these attempts have been apparently unsatisfactory (Griffin et al 1998). One reason may be because these policies have often evolved towards the sharing of resource rents among those who have high import propensities for non-productive goods and who, for a number of reasons, place their assets offshore.

The model in this section illustrates this intuition as well as the conditions under which it is valid. It uses the fisheries model based upon the assumptions of Gordon and Schaefer, and the Keynesian model of an open economy in short term equilibrium, as presented by Muet (1990). The two models describe, respectively, the fisheries sector (Sector 1) and the rest of the economy (Sector 2). We will be taking fisheries sector employment as exogenous. The employment in the rest of the economy is endogenously determined by the macroeconomic policy variables that affect aggregate demand, as well as fisheries policy.

Labor is the abundant factor in this economy, and so we argue that the opportunity cost is the subsistence wage of the economy, which is positive but small. A positive subsistence wage does not seem to be inconsistent with the Keynesian assumptions, because that assumption is actually a statement about the role of labor in bidding up the price level as aggregate demand grows. If employment is observed to increase at some given wage without an increase in the price level as demand grows, then we might conclude that there is no scarcity of labor, and consequently no bidding up of the price level. Access to fisheries resources is controlled by the government, which is why N_I is an exogenous policy variable.

3.1. The Fisheries Sector (Sector 1)

The sustainable fisheries production Y_I is described in the usual way using a global production function based upon the Schaefer model. Employment in the fishery (N_I) is taken as an index of effort in the fishery:

$$(3.1) \quad Y_I = f(N_I); f''(N_I) < 0;$$

$$(3.2) \quad f'(N_I) \geq 0 \text{ as } N_I \leq N_{Imsy}.$$

To simplify the exposition, and also because for poorer countries it is sometimes reasonable, the entire production of this sector is exported, and represents the only exports

(X) of the country, such that $X = Y_I$. Exporters are price takers on the world market for their product, and fishing firms spend W as the wage for effort. The value WN_I is entirely spent on goods, with the marginal propensity to consume domestic goods being a_w ($0 < a_w < 1$). The rest of WN_I buys import items.

The fisheries rent, $R = Y_I - WN_I$, will be defined as usual. The rents are maximum for $N_I = N_I^*$, and zero when $N_I = N_I^{**}$ (Figure A-1a). The employment N_I^{**} corresponds to the standard notions of "open access." This implies that $N_I \leq N_I^{**} \Leftrightarrow R \geq 0$.

The aggregate and the import demand from the fishery sector is:

$$(3.3) \quad D_I = a_w WN_I + a_R R;$$

$$(3.4) \quad M_I = (1 - a_w)WN_I + (1 - a_R)R.$$

We will not explore the institutions whereby resource rents are divided in poorer countries, although it is an interesting topic. With regard to the initial conditions confronted by fisheries managers in developing countries, it is not true that these countries are confronted with classical open access conditions. Sometimes, the productive capacity of the fishing sector is suspected to be smaller than the biological capacity, as might be the case in Haiti. In the case of Madagascar, the government has experimented for the last twenty years with different forms of effort management, and they even had a fairly well defined policy of "private" zonal management in the north-western part of the country (Greboval, 1996). Further, there may be, at least tacitly, an institutional preference for such arrangements, since they allow the government to partially transfer management responsibility to a long-term contractor. It also enables the government to negotiate with and manage a limited number of large companies that can be taxed or incited to give other economic considerations to maintain their positions. Therefore some countries have already experimented with policies that result in something like employment at N_I^* . The rents generated under these types of policies are probably distributed between public servants, the treasury of the country, and the resource users. All of these groups, even those who receive informal transfers, can contribute to economic growth in the country by the consumption of both domestic and imported goods used in production.

However, we argue that those who have access to rent under these concessions spend a proportionately greater percentage of it on goods that are directly unproductive. For example, in Madagascar, anecdotal evidence from members of the industry suggest that informal payments by members of the industry to past fisheries ministers went to finance political campaigns for higher office.

There may be positive effects to campaign spending for an economy, but in poorer countries, it is a safe bet that rents could be better used to finance surveillance activities in the fishery, for example. We therefore assume that rent holders have a marginal propensity to consume domestic goods of a_R ($0 < a_R < 1$), and that $a_R < a_w$.

This raises the issue of which condition dominates, or should dominate, in countries like Madagascar. The Malagasy government has experimented with forms of regional fisheries management for the shrimp fishery that would seem *a priori* to be efficient. However, at least some Malagasy nationals view the major producers in the fishery as rich foreigners having cozy relationships with the Malagasy government. This perception as well as the possibility of economic gain may be inciting a new wave of small-scale fisherman to enter the shrimp fishery. These fishermen, called "traditional," are small-scale entrepreneurs. They collectively ignore the deals the Malagasy government has made with the larger producers. These fishermen, with the help of smaller export enterprises called "collectors", as well as the chiefs of their respective kingdoms (see for example the work of Breton et al 1997), are beginning to threaten the positions of the more established industrial fishermen in Madagascar. The industrials argue rightly that past agreements with the Malagasy government have resulted in zonal management of the shrimp fishery that is both highly organized and economically efficient. Opponents of the industrials argue that these firms are rent seekers whose marginal contributions to the country economy are minimal at best. In addition, the fisheries zones to the southwest of the island are non-exclusive, resulting in fierce competition among industrial fishing groups within these zones.

Finally, government officials understand that it is politically advantageous to argue for more industrial licenses to national fishermen, although some of these permits go to high officials in government. Overlaying this debate is the fact that the shrimp fisheries in Madagascar is one of the richest in the world, and the predominantly export oriented industry accounted for more than 20% of export value from Madagascar in 1996. Therefore, the question of what fisheries policy to favor, from a macroeconomic standpoint, is an interesting one.

3.2. The Rest of the Economy (Sector 2, Figure A-1b)

The employment N_2 in the rest of the economy depends upon the level of national production Y_2 :

$$(3.5) \quad N_2 = g(Y_2); g'(Y_2) > 0.$$

National production in the rest of the economy depends on the global demands in the fisheries sector and in the rest of the economy. In equilibrium, $Y_2 = D_1 + D_2$. The

demand from the rest of the economy is composed of an autonomous (A) and an induced element:

$$(3.6) \quad D_2 = a_2 Y_2 + A \quad (0 < a_2 < 1).$$

The parameter a_2 is the marginal propensity to consume by those in the rest of the economy. The demand for output-induced imports in sector 2 is:

$$(3.7) \quad M_2 = m_2 Y_2 \quad (0 < m_2 \leq 1 - a_2).$$

The parameter m_2 is the marginal (and average) propensity to import in the rest of the economy. The external trade balance is $S = X - M_1 - M_2$.

3.3 A view of the complete model

The structural model is composed of the following ten equations describing the endogenous variables:

- (1) $Y_1 = f(N_1)$; Aggregate fisheries production;
- (2) $X = Y_1$; Exports equation;
- (3) $R = Y_1 - WN_1$; Fisheries rent;
- (4) $D_1 = a_w WN_1 + a_R R$; Demand (consumption and investment) Sector 1;
- (5) $M_1 = (1 - a_w)WN_1 + (1 - a_R)R$; Import demand, Sector 1;
- (6) $N_2 = g(Y_2)$; Employment function, Sector 2;
- (7) $Y_2 = D_1 + D_2$; Global demand, Sector 2;
- (8) $D_2 = a_2 Y_2 + A$; Sector 2 demand for sector 2 products;
- (9) $M_2 = m_2 Y_2$; Import demand for Sector 2;
- (10) $S = X - M_1 - M_2$; Net exports equation.

The following exogenous variables are represented:

- $N_1 =$ Fisheries employment ($0 \leq N_1 \leq N_1^{**}$);
- $W =$ The subsistence wage of fishermen ($0 < W$);
- $A =$ Autonomous demand in Sector 2 ($0 < A$);
- $a_w =$ Propensity of Sector 1 to consume products from Sector 2 ($0 < a_w \leq 1$);
- $a_R =$ Propensity of rent seekers to consume products in Sector 2 ($0 \leq a_R < a_w$);
- $a_2 =$ Propensity to consume Sector 2 products by the rest of the economy ($0 < a_2 < 1$);
- $m_2 =$ Marginal propensity to import ($0 < m_2 \leq 1 - a_2$).

3.3. The Reduced Form

The variable of direct interest is the impact of the choice variable N_1 on global demand through D_1 , and the impact that re-distributions may have on Y_2 through the net export equations. A simplification of Sector 1 would be:

$$(3.8) \quad D_1 = a_R f(N_1) + (a_w - a_R)WN_1$$

$$(3.9) \quad M_1 = (1 - a_R)f(N_1) - (a_w - a_R)WN_1$$

In this model, the partial trade balance equation is the Sector 1 demand:

$$(3.10) \quad X - M_1 = f(N_1) - (1 - a_R)f(N_1) + (a_w - a_R)WN_1$$

$$= a_R f(N_1) + (a_w - a_R)WN_1$$

$$= D_1$$

The variables Y_2 , D_2 , M_2 , N_2 et S can also be explained in terms of D_1 . We saw before that the expression $(X - M_1)$, the partial trade balance equation due to the activities of the fishery, is equal to the global demand from that sector. Substituting $(X - M_1)$ with D_1 we obtain $S = [D_1(1 - a_2 - m_2) - Am_2] / (1 - a_2)$.

The equations for the rest of the economy can be re-expressed as functions of N_1 , resulting in:

$$(3.11) \quad Y_2 = [a_R f(N_1) + (a_w - a_R)WN_1 + A] / (1 - a_2)$$

$$D_2 = [a_R f(N_1) + (a_w - a_R)WN_1 + A]a_2 / (1 - a_2)$$

$$M_2 = [a_R f(N_1) + (a_w - a_R)WN_1 + A]m_2 / (1 - a_2)$$

$$N_2 = g [[a_R f(N_1) + (a_w - a_R)WN_1 + A] / (1 - a_2)]$$

$$S = [a_R f(N_1) + (a_w - a_R)WN_1 + A](1 - a_2 - m_2) / (1 - a_2) - A m_2 / (1 - a_2)$$

3.4. Discussion of the Basic Results

The global demand generated by Sector 1 figures in all of the reduced form equations for the variables Y_2 , D_2 , N_2 , M_2 and S . Further, these functions are increasing in D_1 . Therefore, it is sufficient to look at the impact of changes in N_1 on the behavior of D_1 . The derivative of D_1 with respect to N_1 is:

$$(3.12) \quad dD_1 / dN_1 = a_R f'(N_1) + (a_w - a_R)W.$$

Upon inspection, the signs of the derivative will be:

$$(3.13) \quad dD_1 / dN_1 > 0 \text{ when } f'(N_1) > (1 - a_w/a_R)W;$$

$$dD_1 / dN_1 = 0 \text{ when } f'(N_1) = (1 - a_w/a_R)W; \text{ and}$$

$$dD_1 / dN_1 < 0 \text{ when } f'(N_1) < (1 - a_w/a_R)W.$$

The growth in the economy will vary directly with the employment in the fisheries sector as long as the marginal productivity of labor in the fishery is greater than $(1 - a_w/a_R)W$. However, $a_w > a_R$, for reasons that we see in the field. This means that under conditions we believe to be reasonable in many poor countries, policies that favor employment in the fisheries sector may be preferred, from a macro-economic point of view, to the recommendations of either biologists or fisheries economists. That is, the macroeconomic "optimum" would appear to always be in a range where $f'(N_1) < 0$, or the range of sustainable biological overexploitation, except for the case where

$W = 0$, or when $a_w = a_R$, in which case $f'(N_1) = 0$.

When the marginal productivity of labor falls below this level, the situation is reversed. Therefore, the level of employment which maximizes the economic activity in the rest of the economy as well as the trade balance is a level of N_1^{***} such that:

$$(3.14) \quad f'(N_1^{***}) = (1 - a_w/a_R)W \leq 0.$$

The main results are found in **Figure A-1a**. In this diagram, we have drawn the static bio-economic optimum N_1^* , the point of maximum biological production N_{1MSY} , the open access equilibrium N_2^{**} , and the "macro-economic optimum" (N_1^{***}).

At N_1^* , $f'(N_1^*) > 0$. This implies that for non-negative W , $a_w < a_R$. Assuming that the marginal propensity for the fishing sector to consume Sector 2 products (a_w) is positive and less than the propensity of rent seekers to consume domestic goods (also positive), the "macro-economic optimum" (N_1^{***}) could be found to the left of MSY, in the vicinity of N_1^* . Another way of thinking about this is to note that as a_w and a_R are defined, $f'(N_1^{***}) < W$, but at the bio-economic optimum, $f'(N_1^*) = W$, by definition. This must mean that $N_1^* < N_1^{***}$.

With chronic underemployment, the level of employment in the fishery which maximizes the national revenue in the rest of the economy, and which contributes the most to the balance of trade, is larger than the employment that maximizes resource rent. The case of rent seekers having an equal or higher marginal propensity to consume domestic goods than the rest of the economy seems unreasonable. Poorer countries confront the problem of how to encourage resource users to re-invest in the economy. This is made difficult not only by the small market basket available to consumers, but also by policies which encourage capital flight and corruption. Weak growth is the conclusion to a complex evolution of institutions that reward rent seeking.

The comparison between N_1^{***} and N_{1MSY} is more clear. Under the assumption that $a_w > a_R$, the marginal productivity of labor at N_1^{***} is negative:

$$(3.15) \quad a_w > a_R \Rightarrow (1 - a_w/a_R) < 0 \Rightarrow f'(N_1^{***}) < 0.$$

Remembering that $f'(N_{1MSY}) = 0$, the "macro-economic optimum" will coincide with the "biological optimum" when $a_w = a_R$. Also, the "macro-economic optimum" only coincides with the rent maximizing solution under conditions that seem less realistic.

Finally, the level of employment N_1^{**} that dissipates rents completely is that where $f(N_1^{**}) / N_1^{**} = W$.

There is nothing to stop an “optimum macro-economic equilibrium” from going beyond the open access equilibrium. Indeed there are a number of real cases in both developed and developing countries where sustainability in one sector is sacrificed for the appearance of economic growth by the increase of resource throughput. Some economies like Canada seem at times to be subsidizing the decline of certain resource bases, rather than to encourage re-tooling. However, this is a partial equilibrium analysis, which assumes that an economy is exploiting at least some of their resource margins in a sustainable manner. For employment levels above N_I^{**} , a country is literally robbing Peter to pay Paul. So, for obvious reasons, we write:

$$(3.16) \quad N_I^{***} < N_I^{**} \Leftrightarrow f(N_I^{***}) / N_I^{***} > W;$$

$$(a_w/a_R - 1)f(N_I^{***}) / N_I^{***} > (a_w/a_R - 1)W;$$

$$(a_w/a_R - 1)f(N_I^{***}) / N_I^{***} > -f'(N_I^{***});$$

$$(a_w/a_R - 1) > -f'(N_I^{***}) N_I^{***} / f(N_I^{***}).$$

For any N_I^{***} , if $(a_w/a_R - 1) > -\epsilon(Y_I / N_I^{***})$, then $N_I^{***} < N_I^{**}$. That is, the negative of the elasticity of output in the fishery for a change in N_I must be less than the left side of the equation.

We are not saying that policy makers should adopt labor policy in order to promote some new “macro-economic optimum.” We are saying that where there are serious doubts as to the ultimate macroeconomic outcome of rent capture policies, then policies encouraging fuller employment managed in a sustainable manner may produce more real output than policies that simulate the sole owner solution. On the other hand, we know, mainly through the contributions of ecological economists, that non-sustainable practices can show up as short-term economic growth, due mainly to resource throughput in an economy. Under the Keynesian labor supply assumptions, which seem reasonable for poor countries, the recommendations of fisheries economists and ecological economists should be tempered by those realities.

No attempt is made to reconcile the question of long term and short term between the two sub-models. In the fisheries, adjustments to the competitive or “open access” equilibrium are thought to be cyclic and take years, whereas a fisheries policy which reduces capacity can either be gradual or very abrupt. On the other hand, the multiplier effects of standard fiscal policy are thought to play themselves out over a period of months. Fundamental changes in the productive capacity of a nation widen the gap between real and potential GNP and can change employment outlooks as well. These results would argue that development organizations that focus on

rent capture and resource rationalization policies, in order to increase the public finances of a country, may perpetuate the problems they wish to eliminate. Rent capture policies often work best with a limited number of domestic and foreign resource users who are easily identifiable and therefore easy to negotiate with. Unfortunately, the transactions cost conditions that are propitious for enacting such policies are also propitious for economic behavior that will undermine these same policies. We take the view that until public management institutions are strong enough to deal with user groups who will most likely form coalitions to protect their own interests, the more prudent policy is to let most of the resource rents dissipate into the economy.

4. TWO INDUSTRIAL ORGANIZATIONS AND TWO TECHNIQUES OF PRODUCTION

The fisheries management dilemmas encountered in countries like Madagascar may have to do with changing transactions cost environments and the stability of micro-economically “optimal” organization in the industry. So-called “optimal” industrial organizations that were the results of management experiments eventually might give way to open access conditions, not only among industrial fishing firms, but also among traditional or artisanal fishers. As new opportunities in export markets develop, new entry may occur. Public managers might “control” industrial fishing firms, but since members of the public sector are rent seekers themselves, the durability of such “optimal” industrial organizations is in doubt. On the other hand, traditional fishers, because of their numbers and also because of political demography, may simply be harder to manage. In such situations, intense debates arise as to which type of industrial organization actually contributes the most to the economy. In the case of the Madagascar shrimp fishery, this has been the subject of detailed study (SEPIA, 1998a and 1998b).

To gain some intuition that may help in understanding what policies to favor, suppose that we use the standard logistic model of stock growth:

$$(4.1) \quad dB / dt = rB(1 - B / B_{max}), \text{ where;}$$

B = Stock biomass;
 dB / dt = Instantaneous growth of the stock;
 B_{max} = Carrying capacity;
 r = Intrinsic rate of growth of the stock.

In the absence of exploitation, the biomass at which dB / dt is maximum is $0.5 B_{max}$, and the corresponding value for $dB / dt = 0.25r B_{max}$. In addition, suppose that fishing effort is proportional to employment or N_I . In addition, two technologies exist for fishing: traditional (I) and industrial (II), each having different capturability

coefficients, q_i , such that $q_I < q_{II}$. Equilibrium production is defined as $Y_i = dB/dt$, such that:

$$(4.2) \quad Y_i = f_i(N_i) = B_{max} q_i N_i (1 - q_i N_i / r). \\ (i = I, II)$$

The maximum production under either technology is $MSY = 0.25rB_{max}$. However, both the employment at the maximum, $N_{i,MSY} = 0.5r / q_i$, as well as the employment that drives equilibrium yield to zero ($N_{i,max} = r / q_i$) will be different depending upon the technology ($i = I, II$). We assume that because of the capturability coefficients, the two employment values for the traditional sector would lie above those of the industrial sector.

4.1 Fishing costs and fisheries rents

For this discussion, we let the world price be the same and unitary for both technologies¹ ($P = 1$). Our unit cost W_i is still the cost of effort, but it is different according to the technology under consideration ($i = I, II$). Rent can then be described as before: $R_i = f_i(N_i) - W_i N_i$ ($i = I, II$), and $W_I < W_{II}$. However, $W_I / q_I > W_{II} / q_{II}$, which means that the industrial sector is technically more efficient in comparison with the costs per-unit of effort. From the bio-economic equilibrium conditions, we can say that $R_i = q_i .BN_i - W_i N_i$ ($i = I, II$), and the difference between the rents under the two technologies can be described as;

$$(4.3) \quad R_{II} - R_I = B(q_{II}N_{II} - q_I N_{I1}) - (W_{II}N_{II} - W_I N_{I1}).$$

N_{I1} and N_{II} is the employment under each technology².

4.2 Defining Possible Equilibriums in the Fishery

Policy makers confront two extremes between which they try to strike a balance. These are common pool solutions and rent maximizing solutions. For each technique, we look for the output, employment, cost, and rent characteristics. Under the assumptions, these are:

1) The rent maximizing points (N_{i1}^* , Y_{i1}^*):

$$(4.4) \quad N_{i1}^* = (0.5r / q_i)(1 - W_i / q_i .B_{max}) \\ (i = I, II)$$

$$(4.5) \quad Y_{i1}^* = (0.25r .B_{max})(1 - W_i^2 / q_i^2 .B_{max}^2) \\ (i = I, II)$$

2) The rent dissipating points (N_{i1}^{**} , Y_{i1}^{**}):

$$(4.6) \quad N_{i1}^{**} = (r / q_i)(1 - W_i / q_i .B_{max}); \\ (i = I, II)$$

$$(4.7) \quad Y_{i1}^{**} = (rW_i / q_i)(1 - W_i / q_i .B_{max}). \\ (i = I, II)$$

3) The costs and the rents at the rent maximizing equilibriums:

$$(4.8) \quad W_i N_{i1}^* = (0.5r / q_i)(1 - W_i / q_i .B_{max}) \\ (i = I, II)$$

$$(4.9) \quad R_i^* = Y_{i1}^* - W_i N_{i1}^* = (0.25r B_{max})(1 - W_i / q_i B_{max})^2 \\ (i = I, II)$$

Some poor countries may have, possibly for reasons having little to do with promoting economic efficiency, put policies in place that closely resemble those that would promote an efficient solution. These have mainly been with the industrial sector. On the other hand, these same countries have important reserves of human capital that perform basic or traditional fishing activities. The transaction costs for optimally managing this fishery are often thought to be prohibitive, thus leaving it essentially in a common pool situation. For these reasons we consider these two regimes in the fishery: traditional techniques (I) in an open access regime (at N_{I1}^{**} , Y_{I1}^{**}), and industrial techniques (II) under a regime of rent maximization (at N_{II}^* , Y_{II}^*) (**Table 1**).

4.3 Macro-economic impacts through changes in D_i

The same macro-economic assumptions are invoked as before, with the following exceptions. First, we will assume that the unit cost of employment in the fishery, for each technique W_i ($i = I, II$) has a certain percentage of imports between zero and 1, and that these propensities to import are ordered: $0 < m_{WI} < m_{WII} < 1$.

We will further assume that those who receive rents from the fishery have a marginal import propensity for these rents m_R ($0 \leq m_R \leq 1$) that can be different from the ones above. This is a sensitive topic between producers and public managers in poor countries. Producers often claim that the reason they evade taxes is because the public sector is corrupt, provides few services, and so the private sector pays for services normally provided by the public sector. Public managers argue on the other hand that the private sector hides rents and takes undue advantage of already liberal tax laws. The truth is probably a mix of these two complaints. We are arguing that the rents, however they are distributed, will be used differently from expenditures for imports of productive activities.

¹ We drop this assumption in the last part of this section.

² If the marginal costs of employment under the two technologies are the same, then $W_{II}N_{II} = W_I N_{I1} \Leftrightarrow N_{II} = (W_I / W_{II})N_{I1}$, and we then write $R_{II} - R_I = SN_{I1}[q_{II}(W_I / W_{II}) - q_I]$. This means that rents are greater using technique II than with technique I iff $(W_I / q_I) > (W_{II} / q_{II})$.

Table 1

	Traditional technique; open access	Industrial technique; rent maximizing
Effort	$N_{1I}^{**} = (r/q_I)(1 - W_I/q_I B_{max})$	$N_{1II}^* = (r/2q_{II})(1 - W_{II}/q_{II} B_{max})$
Production	$Y_{1I}^{**} = (rW_I/q_I)(1 - W_I/q_I B_{max})$	$Y_{1II}^* = (rB_{max}/4)[1 - (W_{II}/q_{II} B_{max})^2]$
Cost	$W_I N_{1I}^{**} = (rW_I/q_I)(1 - W_I/q_I B_{max})$	$W_{II} N_{1II}^* = (rW_{II}/2q_{II})(1 - W_{II}/q_{II} B_{max})$
Rent	$R_I^{**} = 0$	$R_{II}^* = (rB_{max}/4)(1 - W_{II}/q_{II} B_{max})^2$

The Sector 1 aggregate demand from fishing is therefore:

$$(4.10) \quad D_1 = (1 - m_{W_i})W_i N_i + (1 - m_R)R_i \quad (i = I, II)$$

The exports and trade balance equations from this sector are defined as before, so that the impact of changing N_i is directly felt on global demand and consequently output in the rest of the economy. The "macro-economic optimum" N_{iI}^{***} that maximizes D_1 , for each technique considered, is found by setting $\partial D_1 / \partial N_i = 0$. For the forms we are using this first derivative is:

$$(4.11) \quad \partial D_1 / \partial N_i = (1 - m_R)f_i'(N_i) + (m_R - m_{W_i})W_i, \text{ so that at the optimum, } f_i'(N_{iI}^{***}) = W_i(m_{W_i} - m_R)/(1 - m_R).$$

The value $(m_{W_i} - m_R)/(1 - m_R) < 1$, which implies that the marginal productivity of employment is less than W_i . This also implies that this level of employment is larger than the N_{iI}^* that maximizes rent R_i . There can be no correspondence of these two optimums unless $m_{W_i} = 1$, where the fishing sector exclusively imports.

Further, if the import propensity for the rents exceeds the import propensity associated with the costs of fishing, the optimality condition implies that the marginal productivity of employment in the fishery is negative at N_{iI}^{***} . In this case, the fishing sector employment that maximizes economic growth, regardless of the technique, is superior to the fishing employment $N_{iI.MSY}$.

4.4 Comparative macro-economic impacts of the two techniques

The main interest is to investigate how the results in **Appendix Table A-1** affect D_1 , and consequently Y_2 .

4.4.1 Traditional technique in open access (at N_{1I}^{**}, Y_{1I}^{**})

In the case of the traditional fishery in open access, the resource rents are dissipated into the economy, and the demand from the fisheries sector is:

$$(4.12) \quad D_{1I}^{**} = (1 - m_{W_I}) \cdot W_I N_{1I}^{**}.$$

In making substitutions for N_{1I}^{**} taken from Table 1 we re-write:

$$(4.13) \quad D_{1I}^{**} = (1 - m_{W_I})r(W_I/q_I)(1 - W_I/q_I B_{max}); \quad D_{1I}^{**} = (1 - m_{W_I})rx_I(1 - x_I/B_{max}); \quad x_I = W_I/q_I.$$

4.4.2 Rent maximizing industrial techniques (at N_{1II}^*, Y_{1II}^*)

Beginning with the definition of aggregate Sector 1 demand under the previous assumptions, we obtain:

$$(4.14) \quad D_{1II}^* = (1 - m_{W_{II}})W_{II} N_{1II}^* + (1 - m_R)R_{II}^*$$

Again, using **Table 1** as a source of variables, we obtain:

$$(4.15) \quad D_{1II}^* = r[0.5(1 - m_{W_{II}})(W_{II}/q_{II})(1 - W_{II}/q_{II} B_{max}) + 0.25(1 - m_R)B_{max}(1 - W_{II}/q_{II} B_{max})^2]; \quad D_{1II}^* = r[0.5(1 - m_{W_{II}})x_{II}(1 - x_{II}/B_{max}) + 0.25(1 - m_R)B_{max}(1 - x_{II}/B_{max})^2]; \quad x_{II} = W_{II}/q_{II}$$

4.4.3 Demand differences under the two regimes

From the two measures of D_1 above, an index of demand difference between industrial regime and traditional regime can be formed:

$$(4.16) \quad D_{1II}^* - D_{1I}^{**} = (r/B_{max})[0.25(1 - m_R)(B_{max} - x_{II})^2 + 0.5(1 - m_{W_{II}})x_{II}(B_{max} - x_{II}) - (1 - m_{W_I})x_I(B_{max} - x_I)].$$

This difference depends upon several parameters and their relative magnitudes. The bio-technical parameters of population growth are clearly linked to the growth characteristics of the economy. The technical and economic parameters, x_I and x_{II} of the different technologies, will have an important impact upon the

results as well. We have postulated that $B_{max} > x_I = W_I / q_I > x_{II} = W_{II} / q_{II} > 0$. The economic parameters m_{W_I} et $m_{W_{II}}$ are propensities to import from among the inputs used to execute fishing activities for traditional (I) and industrial (II) sectors of the fishery. The order of these values is $0 < m_{W_I} < m_{W_{II}} < 1$. A controversial parameter, m_R , is the proportion of the rents that are used for directly unproductive imports, with $0 \leq m_R \leq 1$.

The difference function defined in (4.16) is a decreasing function of m_R ; as m_R becomes larger, the difference between the industrial sector impacts and the traditional sector impacts, both positive, become smaller and eventually negative³. Positive values would suggest that the industrial sector has a greater marginal impact on the overall economy than does the traditional sector, and vice versa as the signs change. This difference is never positive unless the import propensity for the rent, m_{RS} , conforms to the following condition:

$$(4.17) \quad m_{RS} < 1 - [(1 - m_{W_I})(B_{max} - x_I)x_I - 0.5(1 - m_{W_{II}})(B_{max} - x_{II})x_{II}] / [0.25(B_{max} - x_{II})^2].$$

In other words, if the parameter falls above this condition, then it is better at the margin for the economy to promote policies of open access fishing by a traditional or artisanal sector. This is because the fishery exploited by an industrial sector and maximizing the rents to the resource would generate an external trade balance and growth in the rest of the economy that would be less than if the fishery were exploited by traditional fishermen in open access.

As an illustration, **Appendix Table A-1** presents $D_{I_{II}^*} - D_{I_{I}^{**}}$ as a function of m_R and the ex-vessel prices of shrimp from the traditional sector in Madagascar, as a percentage of the industrial weighted average ex-vessel prices. These are very gross figures: Greboval (1996) and SEPIA (1998) provide much more detail than this simple model can accept. We also assign an arbitrary virgin biomass value and intrinsic rate of growth parameter ($B_{max} = 100$; $r = 0.1$)⁴. The catchability coefficients are deduced from the relative productivity of the two sectors, and are $q_I = 0.05$ and $q_{II} = 1$. The unit cost estimates, again to come close to the right magnitudes, are taken from the estimates of consumption in both sectors provided by SEPIA (1998). These are $W_I = 1$ and $W_{II} = 8.88$. The import propensities are estimated at $m_{W_I} = 0.01$ and $m_{W_{II}} = 0.32$, based upon the best data from the field.

³ $\partial(D_{I_{II}^*} - D_{I_{I}^{**}}) / \partial m_R = -0.25.B_{max}.(1 - x_{II}/B_{max})^2 < 0$.

⁴ As a passing note, the Schaefer model is not normally used to model the dynamics of tropical shrimp. We use it here mainly because it is well known, and not because we think it describes this population correctly.

In looking at **Table A-2**, with the parameter values, the limit value of m_{RS} ranges from 0, if the ex-vessel values in the traditional sector are 26% of the value of the industrial sector, to about 0.45, if the prices were at parity. This means that if prices were at parity in the two sectors, 45% of the rents would have to be spent on directly unproductive imports to incite policies that would favor employment in the traditional sector.

The argument is often raised in countries like Madagascar that the traditional sector contributes little to added value, in part because the quality of the products are not good enough to enter the more lucrative export markets. The simple model bears this out. While the productivity of the industrial sector is highly sensitive to the marginal propensity to use rents on unproductive imports, the productivity of the traditional sector is highly sensitive to the low prices they receive on the world market. In the case of Madagascar shrimp, for example, there are several world market prices, and several different market chains, depending upon the size and quality of the shrimp produced (Greboval, 1996). Shrimp coming from collectors who buy from traditional fishermen are often sold at lower prices. Policy makers are therefore confronted with an important policy trade-off. Can quality in the traditional and the artisanal sectors be raised sufficiently to take advantage of the benefits of demand driven by employment?

5. THE MODEL WITH VARIABLE PRICE LEVELS AND FIXED EXCHANGE RATES

The rent dissipation arguments invoked by fisheries economists are partial equilibrium concepts appropriate for explaining sectoral events. Previous sections demonstrated that sectoral dissipation of rents might actually grow the economy. In this regard, it is important to clearly distinguish between dissipation in a partial sense and real dissipation from an economy, which can occur because of the porosity of an economic system and the effects of inflation. It is interesting to explore the implications of previous results when the Keynesian assumptions of underemployment in the economy are relaxed. That is, as D_{II} affects the rest of the economy, the price levels within the economy change.

To explore this, a further distinction is made between different types of imports. Some imports are substitutes for locally produced products, and others are complementary or non-substitutable. As price levels rise in the country, this will incite producers from within the country to buy less local products and import more from the exterior, since we assume outside prices and exchange rates are fixed by virtue of the fact that the country in question is small. In the modeling section, we are

interested in the impact to the Sector 2 economy of an increment of N_i going either to the traditional fishery or to the industrial fishery.

5.1. The fisheries sector (Sector 1)

There are seven endogenous variables in Sector 1:

Y_{1i}	Volume in Sector 1 with technique i ($i = I, II$)
X_1	Value of the exports in sector 1;
W_{1i}	The unitary cost of effort by technique i ($i = I, II$);
R	Fisheries rent;
D_{12}	The demand in sector 1 of products that could be furnished by Sector 2;
M_{1C}	The value of non-substitute imports in Sector 1;
S_1	The external trade balance of Sector 1.

These variables are interpreted in much the same way as in previous section. For example, the fisheries production function is still based upon a Schaefer growth model, and the production of this sector is again completely exported. The only change is that now, P_{1i} is different according to the technique being used. It is worth noting that it is not always true that the traditional or artisanal fishing fleets deliver an inferior product that sells at a low price. The artisanal export market chains in the islands of Bahia have higher prices than in the industrial sector, and in the case of Haiti, the quality of the industrially caught fish sold in Port-au-Prince is often lower in quality than the artisanally caught fish from the villages.

The unit costs of employment in the fishery are related to the price level of the rest of the economy, the quantity of locally produced goods, λ_i , and the quantity of non-substitutable goods consumed by a unit of effort, μ_i :

$$(5.1) \quad W_{1i} = \mu_i + \lambda_i P_2. \\ (i = I, II)$$

We assume that for the two techniques we have described, that $\mu_I < \mu_{II}$, and that the unitary price of non-substitutable imports is fixed at unity (1). Also, assume that $\lambda_I / \mu_I > \lambda_{II} / \mu_{II}$. This means that local products make up a greater percentage of the unit costs for traditional fisheries than they do for industrial fisheries. These parameters μ_i et λ_i include intermediate consumption, depreciation, and other products consumed by the fishing sector.

The rent is defined as before. For either technique, assume that the rent can be used to buy local products, or imports, or can be invested offshore. The fishery also operates in a range where $R \geq 0$, and subsidies do not exceed the value of R at the equilibrium. Aggregate Sector 1 demand that affects sector Sector 2 is thus:

$$(5.2) \quad D_{12} = \lambda_i N_1 + a_R R / P_2 ;$$

where a_R ($0 \leq a_R \leq 1$) is the rent holders' propensity to buy local goods.

Non-substitutable imports of Sector 1 are a composite of the spending by a fishing sector on the cost side, plus the spending on non-substitutable imports by holders of resource rent:

$$(5.3) \quad M_{1C} = \mu_i N_1 + (1 - a_R)R .$$

The partial external trade balance generated by Sector 1 is:

$$(5.4) \quad S_1 = X_1 - M_{1C} \\ = (\mu_i N_1 + (1 - a_R)R) + (\lambda_i P_2 N_1 + a_R R) - \\ M_{1C} \\ = M_{1C} + P_2 D_{12} - M_{1C} \\ = P_2 D_{12}.$$

S_1 is the value of the demand of Sector 1 for goods produced locally. With P_2 as exogenous, the 7 endogenous variables can be identified:

$$(5.5) \quad Y_{1i} = f_{1i}(N_1) \\ X_1 = P_{1i} Y_{1i} = P_{1i} f_{1i}(N_1) \\ W_{1i} = \mu_i + \lambda_i P_2 \\ R = X_1 - W_{1i} N_1 = P_{1i} f_{1i}(N_1) - (\mu_i + \lambda_i P_2) N_1 \\ D_{12} = \lambda_i N_1 + a_R R / P_2 = (1 - a_R) \lambda_i N_1 \\ + a_R (P_{1i} f_{1i}(N_1) - \mu_i N_1) / P_2 \\ M_{1C} = \mu_i N_1 + (1 - a_R)R = a_R \mu_i N_1 \\ + (1 - a_R)(P_{1i} f_{1i}(N_1) - \lambda_i P_2 N_1) \\ S_1 = X_1 - M_{1C} = P_2 D_{12} = P_2 (1 - a_R) \lambda_i N_1 \\ + a_R (P_{1i} f_{1i}(N_1) - \mu_i N_1)$$

5.2 The Rest of the Economy

Seven endogenous variables comprise Sector 2:

Y_2	Production volume;
N_2	Employment;
P_2	Price level;
D_{22}	Sector 2 demand for locally produced products;
M_{2S}	Sector 2 imports of substitutable products from sector 2;
M_{2C}	Imports of goods complementary to products from Sector 2;
S	External trade balance for the economy.

In the short term, with a fixed capital stock, employment is the variable of interest. The production function with employment as an argument has the following form:

$$(5.6) \quad Y_2 = f_2(N_2); \quad f_2'(N_2) > 0; \quad f_2''(N_2) < 0; \\ \lim_{N_2 \rightarrow \infty} (f_2(N_2)) = Y_{2\max}.$$

The inverse of this function, or $N_2 = f_2^{-1}(Y_2)$, is called the employment function. An example of such a functional form would be a Spillman, which will be used later in an exercise:

$$(5.7) \quad Y_2 = Y_{2\max} (1 - e^{-\alpha N_2}); \quad (\alpha > 0).$$

The inverse or employment function is:

$$(5.8) \quad N_2 = [\ln Y_{2\max} - \ln(Y_{2\max} - Y_2)] / \alpha.$$

The price level is the marginal cost of the output in Sector 2, which is the formal definition of aggregate supply in the short term:

$$(5.9) \quad P_2 = C_m(Y_2) = W_2 dN_2 / dY_2 = W_2 f_2^{-1'}(Y_2).$$

It is important to note that the objective is to obtain a measure of actual national output and price level, and not potential or long-term supply. The global short-run supply is asymptotic to full employment output.

The aggregate demand is composed of two elements. One is the demand from the fishery D_{12} , and the other is demand in Sector 2, D_{22} . Demand $D_{22} = A + a_2 Y_2$, where A is autonomous demand and a_2 is Sector 2 marginal propensity to consume (local goods) ($0 < a_2 < 1$).

The demand for local products that could be produced locally ($D_{12} + D_{22}$) will be satisfied by local production and imports of substitutable goods:

$$(5.10) \quad D_{12} + D_{22} = Y_2 + M_{2S}.$$

There are no tariff or non-tariff barriers, and the volume of demand depends exclusively on the competitiveness of interior production compared to production coming from elsewhere. Because of the assumptions we have made concerning fixed exchange rates and world prices, the degree of penetration of imports is positively related to the price level in the economy. There is some $\varphi(P_2)$, where $\varphi'(P_2) > 0$; and $0 \leq \varphi(P_2) < 1$, and that $M_{2S} = (D_{12} + D_{22}) \cdot \varphi(P_2)$. For example, one might say that $\varphi(P_2) =$

$P_2 / (P_2 + \beta)$, where β represents a positive parameter related to the baseline demand when the interior and exterior price levels are equivalent. Global Sector 2 demand is then defined as $Y_2 = D_{12} + D_{22} - M_{2S}$. Making the appropriate variable changes gives a definition of global demand, which is decreasing in P_2 :

$$(5.11) \quad Y_2 = (D_{12} + A)(1 - \varphi(P_2)) / [1 - a_2(1 - \varphi(P_2))].$$

Also, D_{12} affects Y_2 directly. For example, using the postulated form $\varphi(P_2) = P_2 / (P_2 + \beta)$, we obtain:

$$(5.12) \quad Y_2^-(P_2) = (D_{12} + A) / [1 - a_2 + (P_2 / \beta)]$$

As before, the only exports are those from the fisheries sector. However, the imports are composed of three important elements. These are the imports of goods that are substitutes of local products (M_{2S}); imports that are complements to activities in Sector 1 (M_{1C}); and imports that are complements to activities in Sector 2 (M_{2C}). Sector 2 imports of complements is expressed as:

$$(5.13) \quad M_{2C} = m_2 Y_2 \quad (0 < m_2 < 1 - a_2).$$

The parameter m_2 is the marginal propensity to import complementary goods by Sector 2. The external trade balance is:

$$(5.14) \quad S = S_1 - M_{2C} - M_{2S};$$

Where ($S_1 = X_1 - M_{1C}$) is the partial trade balance from Sector 1, the fisheries sector. The short term price level of Sector 2, as well as its output, is endogenously determined by the intersection of the aggregate demand and supply curves in the rest of the economy. We assume that D_{12} is exogenous to this process, but that from the short-term equilibrium we would like to know the equilibrium output and price level in Sector 2. From this basic information, the values of the other endogenous variables defined in this section can be determined.

To make the exposition more tractable, we use some simple functional forms proposed above:

$$(5.15) \quad Y_2^+(P_2) = Y_{2\max} - W_2 / (\alpha \cdot P_2)$$

$$(5.16) \quad Y_2^-(P_2) = (D_{12} + A) / [1 - a_2 + (P_2 / \beta)].$$

The equilibrium values of P_2^* and Y_2^* are simultaneously solved (following page):

$$P_2^* = \frac{-\left(Y_{2\max}(1-a_2) - \frac{W_2}{\alpha\beta} - (D_{12} + A)\right) + \sqrt{\left(Y_{2\max}(1-a_2) - \frac{W_2}{\alpha\beta} - (D_{12} + A)\right)^2 + 4Y_{2\max}(1-a_2)\frac{W_2}{\alpha\beta}}}{\frac{2Y_{2\max}}{\beta}} \quad (5.17)$$

$$Y_2^* = \frac{\left(Y_{2\max}(1-a_2) + \frac{W_2}{\alpha\beta} + (D_{12} + A)\right) - \sqrt{\left(Y_{2\max}(1-a_2) + \frac{W_2}{\alpha\beta} + (D_{12} + A)\right)^2 - 4Y_{2\max}(1-a_2)(D_{12} + A)}}{2(1-a_2)} \quad (5.18)$$

Once that the equilibrium values of Y_2^* and P_2^* are determined, the other endogenous variables can be determined using these definitions.

5.3 Interactions between the two sectors

The aggregate demand in Sector 1 directly shifts Sector 2 demand. However, there is a negative feedback effect through the price level in Sector 2, P_2 , with effects on D_{12} .

The magnitudes of the output and price effects from a given equilibrium will depend upon the slope of the aggregate supply curve at that point. If the economy is nearing maximum output, then $\Delta P_2/\Delta D_{12} \Rightarrow \infty$ and $\Delta Y_2/\Delta D_{12} \Rightarrow 0$, and vice versa for cases where the change is in a flatter part of the supply curve. For identical changes in N_I for techniques I and II at identical positions on the

supply curve, a comparison can be made as to the Y_2 output changes.

The effects of the price level P_2 on the other endogenous variables is through two effects: 1) the impact on the consumption of locally produced goods, and 2) the impacts on the purchasing power of the retained rents. These have a direct and negative effect upon D_{12} . We see this by inspecting the reduced form of the aggregate demand for Sector 1:

$$(5.19) \quad D_{12} = (1 - a_R)\lambda_i N_I + a_R(P_{li} f_{li}(N_I) - \mu_i N_I) / P_2$$

Suppose that we are able to specify the penetration rate for substitutes, using for example the expression $\varphi(P_2) = P_2 / (P_2 + \beta)$. Introducing 5.19 and this expression in the aggregate demand for Sector 2, we have:

$$(5.20) \quad Y_2 = \frac{1}{1 - a_2 + \frac{P_2}{\beta}} \left(A + (1 - a_R)\lambda_i N_I + \frac{a_R(P_{li} f_{li}(N_I) - \mu_i N_I)}{P_2} \right)$$

This specification of Sector 2 aggregate demand integrates the feedback effects of P_2 , which reinforces the negative effects of the price level on Y_2 . The new equilibrium values for P_2^* and Y_2^* using these values then demonstrate negative feedback loops related to price level fluctuations.

What do these results mean for the question of favoring one sector over another when promoting fisheries policy? Regardless of which technique one favors, there will be a positive relation between N_I and growth in Y_2 in Sector 2. However, as the economy approaches short run maximum output at the peak of an inflationary cycle, the policy which has the most pronounced effect on demand in Sector 2 will also be the one that contributes the most to inflation. If rationalization and rent capture is thought to

be demand reducing through employment effects, then these policies might have a more positive macroeconomic effect during inflationary periods. However, if a government captures rents without much leakage, a re-injection of these rents into the economy might be better used during a recession. If, on the other hand, the policy systematically encourages the expenditure of rents in directly unproductive ways, the marginal positive impacts of rationalization may be significantly diminished during an inflationary cycle, for the reasons cited above.

6. CONCLUSIONS

We have discussed some conditions where it may be advantageous for a poor country to consider the macroeconomic employment effects of fisheries policy, which might favor more common pool industrial structures. Such a strategy might be recommended if the efficiency of government investment is particularly weak. If corruption and rent-seeking are suspected between government officials and dominant firms, or if the proceeds are essentially spent on unproductive import items, policies which improve the competitive position of fishermen who are more likely, proportionally, to engender economic growth might be preferred.

Such a result calls into question the pertinence of the rent dissipation arguments of fisheries economists. Economic inefficiencies are not necessarily implied by sector dissipation of rents. Overcapacity may be at issue. However, since over-capacity is likely endemic in the general economy anyway, for a number of reasons including demographic ones, it is incumbent on resource managers not simply to demonstrate that a fishery has over-capacity, but that the over-capacity is excessive within some broader context.

Development agencies seem to promote policies in poor countries aimed mainly at capturing and concentrating rents in order to finance fiscal policy, and also to help pay off development loans. The reasons for wanting to do this are clear and laudable (see for example World Bank, 1998). Restructuring programs are aimed at making the public sector work better. However, we have shown that rent concentration in some situations may not be any better than encouraging domestic enterprises to be more competitive in a commons setting, within some well-defined parameters of sustainability. If an economy has been poor for a long period of time, and public management has significantly weakened, our proposition seems even more justified. In these cases, it is not a question of imitating standard fisheries or macro-economic policies as might be practiced in a developed country. Rather, the effort should first involve retraining public managers, helping in the management of information and transactions costs in the public sector, and assisting in the reestablishment of a level of public service and integrity that deserves the responsibilities of stewardship.

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mr	.2347*PI	0.300*PI	0.400*PI	0.500*PI	0.600*PI	0.700*PI	0.800*PI	0.900*PI	PI
0.050	1.97	1.59	1.26	1.06	0.93	0.83	0.76	0.71	0.66
0.100	1.87	1.48	1.15	0.96	0.82	0.73	0.66	0.60	0.56
0.150	1.76	1.38	1.05	0.85	0.72	0.63	0.55	0.50	0.46
0.200	1.66	1.28	0.95	0.75	0.62	0.52	0.45	0.40	0.35
0.250	1.55	1.17	0.84	0.64	0.51	0.42	0.35	0.29	0.25
0.300	1.45	1.07	0.74	0.54	0.41	0.31	0.24	0.19	0.14
0.350	1.35	0.96	0.63	0.44	0.30	0.21	0.14	0.08	0.04
0.400	1.24	0.86	0.53	0.33	0.20	0.11	0.04	-0.02	-0.06
0.450	1.14	0.76	0.43	0.23	0.10	0.00	-0.07	-0.12	-0.17
0.500	1.03	0.65	0.32	0.12	-0.01	-0.10	-0.17	-0.23	-0.27
0.550	0.93	0.55	0.22	0.02	-0.11	-0.21	-0.28	-0.33	-0.37
0.600	0.83	0.45	0.12	-0.08	-0.21	-0.31	-0.38	-0.43	-0.48
0.650	0.72	0.34	0.01	-0.19	-0.32	-0.41	-0.48	-0.54	-0.58
0.700	0.62	0.24	-0.09	-0.29	-0.42	-0.52	-0.59	-0.64	-0.69
0.750	0.52	0.13	-0.20	-0.39	-0.53	-0.62	-0.69	-0.75	-0.79
0.800	0.41	0.03	-0.30	-0.50	-0.63	-0.72	-0.79	-0.85	-0.89
0.850	0.31	-0.07	-0.40	-0.60	-0.73	-0.83	-0.90	-0.95	-1.00
0.900	0.20	-0.18	-0.51	-0.71	-0.84	-0.93	-1.00	-1.06	-1.10
0.950	0.10	-0.28	-0.61	-0.81	-0.94	-1.04	-1.11	-1.16	-1.21
1.000	0.00	-0.38	-0.71	-0.91	-1.04	-1.14	-1.21	-1.26	-1.31

(1) Source of raw data : SEPIA (1998b) and Greboval (1996).

Table A-1. The marginal propensity to import using resource rents (mr), product prices in the traditional sector (as a percentage of industrial prices), and the comparative productivity of each sector. Red (negative) values suggest combinations of ex-vessel prices for the traditional sector and marginal propensities to import for which employment in the traditional sector would result in greater economic growth in the economy.

