Are Two Rents Better than None? When Monopoly Harvester Co-ops are Preferred to a Rent Dissipated Resource Sector

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Abstract

This paper evaluates the conditions under which a fish-harvester cooperative (co-op) with monopoly power represents a preferable outcome when compared to a rent dissipated fishery. Currently, United States anti-trust law prevents harvesters from coordinating to restrict output. In a fishery, this coordination can represent an improvement, despite the creation of market power because a monopolist builds the resource stock. We show, analytically, how a monopolist harvester co-op generates both resource and monopoly rent. While the monopolist generates monopoly rent by restricting production to generate higher prices, it also manages the fish stock to lower stock dependent harvesting costs. We demonstrate the conditions under which a monopoly is likely to be favored over rent dissipation. Given that a monopoly can be efficiency-improving in a common property resource sector, policymakers should consider both the costs and benefits of co-op formation in the case of a rent dissipated fishery.

1. Introduction

Despite the efforts of natural resource economists to implement rights-based fishery management systems, many of the world's fisheries remain over-exploited and lack an institution to change course. In the absence of fishery ownership, fishermen face no incentive to internalize the impact of current harvests on the resource stock and future harvests. This leads to a 'race to fish' as fishermen compete for a share of harvest available to be caught. In many cases, simple restrictions on the inputs allowed in a fishery do little to mitigate the tragedy of the commons that occurs when a resource has no owner. Natural resource economics provides many theoretical explanations (e.g., Homans and Wilen 1997; Gordon 1954; Hardin 1968; Smith 1968) and empirical examples, (e.g., Worm et al. 2009; Myers and Worm 2003) regarding the overexploitation of the world's fisheries in the absence of rights to the fishery.

In this paper, we compare two inefficient outcomes to look for a second-best policy in the case that a first-best solution is not feasible. We show that, while a monopolistic harvester cooperative restricts harvest in the short-run, as fish stocks recover, the monopoly harvest could exceed the rent dissipated harvest, meaning that consumer surplus can *increase* as a result of the monopolist. We discuss the conditions under which this occurs and explicitly disentangle resource and monopoly rents earned by the monopolist. Specifically, a monopoly co-op is more likely to be preferred with more elastic output demand and harvest costs that are highly responsive to the fish population level. We argue that United States antitrust law should weigh the costs and benefits of an exclusive co-op that can choose harvest levels instead of outlawing them *ex ante.* Finally, we present a comparison of the net social benefit of a monopoly co-op relative to the persistence of a rent-dissipated fishery.

Background

In practice, common rights-based management systems include individual transferable quotas (ITQs), Territorial Use Rights Fisheries (TURFs), and harvester co-ops. Costello et al. (2008) points out the success of ITQ systems while TURFs have experienced mixed success in Chile and Japan (Cancino et al. 2007; Gonzales 1996). Harvester co-ops represent a third form of rights-based management, though their legality is unclear. Many authors have pointed out the potential conservation benefits of "Conservation Cartels" (Adler 2004a). For example, Yandle (1998) argues that current antitrust laws prevent many socially beneficial conservation efforts. Adler (2004b) argues that antitrust law should provide more flexibility for non-governmental conservation efforts. While these researchers point out that the benefits from harvester co-ops possibly exceed the costs associated with monopoly power, they do not explore the exact conditions under which a monopolist is preferred to a rent dissipated fishery.

Fish harvester cooperatives have recently emerged both in theory (Deacon 2012) and in practice (Knapp 2007). A co-op that manages a fishery requires that a *group* of fishermen has exclusive use rights in a fishery. This method of rationalization has advantages over ITQs because the co-op decides the distribution of property rights internally. Fishermen may also agree internally on accepted harvest levels. This can facilitate policy implementation because fishermen often remain skeptical of the intentions and knowledge of outside management institutions. Endowed with an exclusive use right, co-op members have an incentive to value the fish stock and account for impacts of harvesting on future catches[3]. Also, Fell (2008) showed that with ITQs, processors capture a significant part of the resource rents created. A co-op may be better positioned to bargain for a greater share of these rents.

Despite the theoretical advantages of fisheries co-ops, many practical concerns remain and attempts to form them face opposition from fishermen and from anti-trust laws in the United States. Because co-ops allow competing businesses to collaborate, they could potentially exercise market power (Uchida and Wilen 2005). Anti-trust laws may apply if co-ops "secure a dominant share through a restraint of trade" (Garstang 1967). This means that United States anti-trust laws potentially make the formation of co-ops illegal. Few co-ops have formed in practice and a likely explanation includes the threat of legal action against them.

US anti-trust law, based on the Sherman Anti-Trust Act of 1890, prevents anti-competitive behavior, which includes restricting output. It also prohibits "unreasonable exclusion of firms from the market" (Kitts and Edwards 2003). The Fishermen's Collective Marketing Act (FCMA) of 1934 exempted fishermen from many of the rules implied by the Sherman Act. Similar to the Capper-Volstead Act of 1922, which exempted agricultural producers from parts of the Act, the FCMA exempted fishermen with the intention of enabling them to bargain for better prices from downstream processors. Under the FCMA, fishermen may coordinate in "catching, producing, preparing for market, processing, handling, and marketing." They may also obtain monopoly power, though cannot force membership or deny membership on "anti-competitive grounds." In 2009, these exemptions were extended to recreational fishermen (FCMA of 2009).

Even with the exemptions provided in the FCMA, fish harvester co-ops with the ability to set total allowable catches internally remain in a legal gray area. Kitts and Edwards (2003) review cases from the mid-1900s when co-ops were not allowed under the FCMA. They point out that co-ops do not violate anti-trust law in fisheries where total allowable catches are set by an outside organization (they provide the example of a salmon fishery co-op in Alaska that received around 70% of quota in 2002—this was upheld as legal, although a later court decision found the co-op illegal under Alaska's Limited Entry Act (Knapp 2007)). While potentially beneficial, this does not allow co-ops to provide a potential alternative to quota-managed fisheries. Because co-ops cannot exclude others from using a fishery, the FCMA does not currently appear to allow co-ops to exclude non-members from using the fishery.

[3] A potential disadvantage of a co-op relative to ITQs is that an improperly managed co-op may experience a tragedy of the commons in which members compete internally to maximize shares of the allowable catch.

Notwithstanding the potential for market power, the formation of a co-op may represent an improvement over an input-regulated fishery because input substitution and the race to fish dissipate returns to the scarce fish stock. Therefore, at equilibrium, the true (dynamic) cost of harvesting exceeds its value. Forming a co-op with market power allows the price of harvest to diverge from its marginal cost. In a fishery, this creates two types of rent. First, is monopoly rent, which forms as increasing harvest would require lowering price and reducing monopoly earnings. The monopolist artificially restricts harvest levels to charge a higher price and creates a deadweight loss as a result.

On the other hand, the monopolist internalizes the full cost of harvest today, meaning the marginal revenue equates to the true marginal cost. This internalizes an implicit payment to the resource stock equal to the dynamic marginal opportunity cost of its use today (Uchida 2006). The 'resource rent' represents a payment for the use of a scarce input. Resource rent, then, is a factor payment made to a natural capital stock. Therefore, this payment is welfare increasing (Knight 1924). The monopolist does not maximize resource rent alone but in the process of maximizing total rent, resource rent is generated as harvest costs fall.

Consequently, in a second-best world, the preferred option is that which produces a smaller deadweight loss in the system. Rent dissipation in fisheries occurs as a result of a missing market for a scarce input. Therefore, antitrust law should focus on the change in welfare that results when a monopoly co-op is created. In the following section we develop a dynamic model of socially optimal and monopoly fishery management to show the conditions under which the monopoly's decisions do not differ substantially from optimal. We also explore the costs and benefits of a monopoly relative to continued rent dissipation. We then discuss the model results and conclude.

2. Model setup

We develop a dynamic model of a fishery with the potential for market power to investigate the circumstances under which a managed fishery with some monopoly rent may represent a social improvement when compared to a fishery where resource rents are dissipated. In a first-best world, this fishery could be regulated in order to maximize the value generated from the resource without the exercise of market power. This would involve the creation of resource rent without monopoly rent. In a second best world where the choice is between open access and a rights-based management policy with potential market power, the preferred outcome depends on how fish sector welfare with monopoly power compares to the rent dissipated welfare. While true open access is rare in practice (Homans and Wilen 1997), the assumption of rent dissipation provides an ideal benchmark to compare a rights-based fishery institution to a conventionally managed fishery. Many cases of regulated open access are subject to similar dissipation of resource value (Campbell and Lindner 1990), though fish stocks may remain higher.

To explore the implications of a monopoly, we start with the fishery model presented in Clark, 1990. We assume that a fishery faces a demand curve, $p(h)$ for harvest level, h and with $p'(h) < 0$. Fishery costs depend on the level of harvest and also on the level of the fish population, x where x can be thought of as a natural capital input to fish production. The harvest cost function is $c(h,x)$ with $c_h > 0, c_x \leq 0, \; c_{xh} \leq 0$. The unmanaged fishery experiences rent dissipation so that $p(h)h - c(h,x) = 0$ and the fish population is approaching a degraded steady state where $F(x) = h$ for the growth function, $F(x)$. $F''(x) < 0$ and F^{max} occurs at x^{MSY} (x and h are functions of time but t subscripts are suppressed throughout for conciseness). These two conditions produce a rent-dissipated steady-state level of harvest and fish population equal to h^{oa}, x^{oa}. We explore if (and under what conditions) the formation of a monopoly harvester co-op represents a social improvement relative to the continuation of rent-dissipation.

The monopolist

A monopolist wants to maximize the present value of a flow of total rents in the fishery, accounting for the harvest level's impact on price. Therefore, total rents represent a combination of monopoly and resource rent. The monopolist's objective function with discount rate, ρ, is:

$$\max_{h_t} \int_0^T \big(p(h)h - c(h,x)\big)e^{-\rho t}dt \quad s.t. \;\; \dot{x} = F(x) - h$$

…with x_0 given. Introducing a co-state variable, λ_m, the Hamiltonian of this problem can be written:

$$H = \; p(h)h - c(h,x) + \lambda_m(F(x) - h)$$

Subscript m indicates the monopolist's solution. The maximum principle states that

$$\frac{dH}{dh_m} = p'(h_m)h_m + p(h_m) - c_h(h_m, x_m) - \lambda_m = 0$$

Which implies that the gap between price and marginal cost is:

$$p(h_m) - c_h(h_m, x_m) = \lambda_m - p'(h_m)h_m$$

In other words, the deviation is a result of resource rent, which captures the dynamic marginal opportunity cost of harvest today (λ_m), and the monopoly mark-up that occurs (captured in$-p'(h)h$). Importantly, λ_m does not represent the optimal marginal resource rent because it assumes continued monopolistic behavior. Despite that, because it represents the internalization of the dynamic cost of harvest today, this term captures the marginal resource rent and allows an overexploited stock to begin to recover as the dynamic cost of harvest is internalized. The state and co-state condition for this problem are:

$$\dot{x}_m = F(x_m) - h_m$$

And

$$\dot{\lambda}_m - \rho\lambda_m = -\left(-c_x + \lambda_m F'(x_m)\right)$$

Combining these with the maximum principle yields the following expression for how harvest evolves through time:

$$\dot{h}_m = \frac{(p'(h_m)h_m + p(h_m) - c_h)\big(\rho - F'(x_m)\big) + c_x + c_{xh}(F(x_m) - h_m)}{p''(h_m)h_m + 2p'(h_m) - c_{hh}}$$

To see how the monopolist's decisions differ from the welfare maximizing harvest path, we next present the social planner's problem in order to compare its results with the monopoly results.

The social planner

The social planner's objective is to maximize the present value of the total surplus in the fishery sector. In other words, with discount rate ρ,

$$\max_{h_t} \int_0^T \left(\int_0^h \big(p(s) - c_h(s,x)\big) ds \right) e^{-\rho t} dt \quad s.t. \;\; \dot{x} = F(x) - h$$

…with x_0 given. With co-state, λ_{sp}, the Hamiltonian becomes:

$$H = \int_0^h \big(p(s) - c_h(s,x)\big) ds + \lambda_{sp}(F(x) - h)$$

…where subscript, sp indicates the social planner's solution. The maximum principle states:

$$p\big(h_{sp}\big) - c_h\big(h_{sp}, x_{sp}\big) - \lambda_{sp} = 0$$

…indicating that, for the social planner, the entire difference between price and marginal cost comes from resource rent. λ_{sp} captures the dynamic opportunity cost of harvest today and efficiency requires that price and marginal cost of non-resource inputs differ by this amount. The state and co-state equations for the social planner are:

$$\dot{x}_{sp} = F\big(x_{sp}\big) - h_{sp}$$

And

$$\dot{\lambda}_{sp} - \rho\lambda_{sp} = -\Big(-c_x + \lambda_{sp} F'\big(x_{sp}\big)\Big)$$

…which combine with the maximum principle to get the optimal equation of motion for harvest:

$$\dot{h} = \frac{\left(p(h_{sp}) - c_h\right)\left(\rho - F'(x_{sp})\right) + c_x + c_{hx}\left(F(x_{sp}) - h_{sp}\right)}{p'(h_{sp}) - c_{hh}}$$

Now, we compare optimal and monopolist necessary conditions and steady states.

Table 1 presents the necessary conditions for the monopolist and for the social planner for ease of comparison.

Table 1: A Comparison of Optimal and Monopolist Management Strategies Allows the Quantification of the Impacts of Co-op Formation.

Condition	**Social planner**
Max principle	$p(h_{sp}) - c_h(h_{sp}, x_{sp}) - \lambda_{sp} = 0$
Co-state	$\dot{\lambda}_{sp} - \rho\lambda_{sp} = -\left(-c_x + \lambda_{sp}F'(x_{sp})\right)$
$\dot{h}$	$\frac{\left(p(h_{sp}) - c_h\right)\left(\rho - F'(x_{sp})\right) + c_x + c_{hx}\left(F(x_{sp}) - h_{sp}\right)}{p'(h_{sp}) - c_{hh}}$
$\dot{x}$	$\dot{x}_{sp} = F(x_{sp}) - h_{sp}$
	Monopolist
Max principle	$p'(h_m)h_m + p(h_m) - c_h(h_m, x_m) - \lambda_m = 0$
Co-state	$\dot{\lambda}_m - \rho\lambda_m = -\left(-c_x + \lambda_m F'(x_m)\right)$
$\dot{h}$	$\frac{(\boldsymbol{p'(h_m)h_m} + p(h_m) - c_h)(\rho - F'(x_m)) + c_x + c_{xh}(F(x_m) - h_m)}{\boldsymbol{p''(h_m)h_m} + \mathbf{2}p'(h_m) - c_{hh}}$
$\dot{x}$	$\dot{x}_m = F(x_m) - h_m$

Steady-state outcomes

Using the necessary conditions of the two planners, we can compare steady-state outcomes. Table 2 demonstrates that both the monopolist and the social planner equate the marginal growth of the fish population to the discount rate plus a negative term that depends on the nature of the cost function and demand curve.

Table 2: Steady-state Conditions for Social Planner and Harvester Monopolist

Social Planner	**Monopolist**
$F'\left(x_{sp}^{ss}\right) = \rho + \frac{c_x\left(h_{sp}^{ss}, x_{sp}^{ss}\right)}{p\left(h_{sp}^{ss}\right) - c_h\left(h_{sp}^{ss}, x_{sp}^{ss}\right)}$	$F'(x_m^{ss}) = \rho + \frac{c_x(h_m^{ss}, x_m^{ss})}{p'(h_m^{ss})h_m^{ss} + p(h_m^{ss}) - c_h(h_m^{ss}, x_m^{ss})}$

The steady-state conditions demonstrate that the monopolist and social planner steady states are the same in the absence of stock-dependent costs. Because $c_x \leq 0$, stock-dependent costs increase the steady-state fish stock relative to the case where $c_x = 0$. Given that $p'(h)h \leq 0$, for a given steady state of x and h,

$$\left|\frac{c_x(h,x)}{p'(h)h + p(h) - c_h(h,x)}\right| \geq \left|\frac{c_x(h,x)}{p(h) - c_h(h,x)}\right|$$

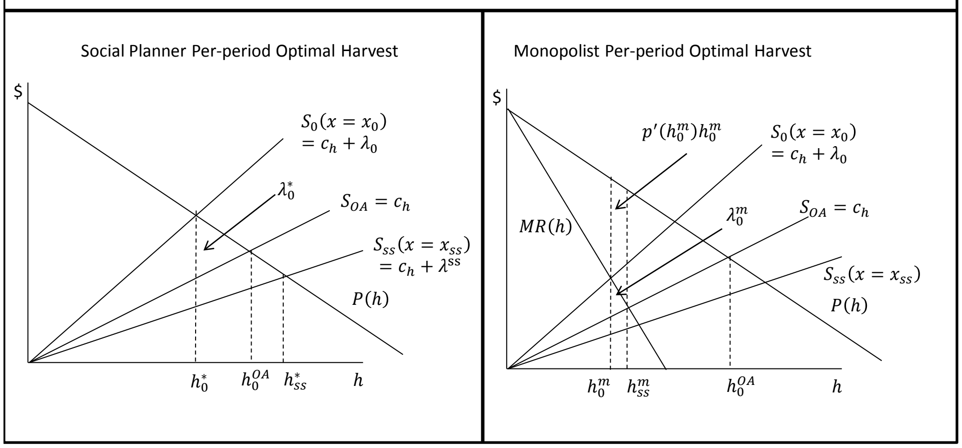
To equate each of these terms (plus ρ) to the marginal fish growth, *the monopolist steady-state fish stock exceeds the social planner's steady-state stock*. Increasing x from the social planner steady state makes $F'(x)$ smaller, which is required for the monopolist's condition to hold. Because it is possible that the social planner steady-state is less than x^{msy} and the monopolist's is greater, the monopolist's sustainable harvest could exceed the socially optimal level. In general, *it is unclear how the monopolist, social planner, and rent dissipated steady-state harvests compare*. They depend on the discount rate and the nature of the cost function but it is possible that the monopolist would have a higher harvest level than the rent dissipated level.

Dynamics

While steady-state harvest levels could exceed or be less than rent-dissipated outcomes, in the short run, both the monopolist and the social planner reduce the harvest from the rent-dissipated level. This occurs as both internalize the dynamic effect of harvesting today. The co-state variable captures this dynamic cost and increases the marginal cost of harvesting conditional on the level of x. Starting from a sub-optimal population level, the incorporation of λ in the per-period optimization problem (by the maximum principle) results in an increase in the fish stock over time. Therefore, because $c_{hx} \leq 0$, this lowers the marginal cost curve over time. Where the marginal cost curve lands relative to the rent-dissipated supply curve depends on how the relative magnitudes of the 'internalization effect' (pushing the per-period supply curve up by accounting for λ) and the 'stock-cost effect' (pushing the per-period supply curve down through time as the stock recovers).

The supply curve shifts over time for both the social planner and the monopolist. The left hand panel of Figure 1 shows how a social planner's per-period supply curve $\left(S_0(x = x_0)\right)$ is above the initial rent dissipated supply curve (S_{OA}) because it considers the dynamic cost of harvest today. The producer surplus under open access is only a return to capital while the surplus with a social planner includes resource rent. This initial jump reflects the internalization effect as the dynamic costs of harvest are now considered. Over time, as the fish stock recovers, this supply curve goes down as marginal costs decrease. This is the stock-cost effect. In the long-run, the curve reaches $S_{ss}(x = x_{ss})$.

Figure 1: Per-period Supply Shifts for Social Planner and Monopolist



The monopolist sees similar shifts in marginal cost but in addition, equates marginal cost to marginal revenue instead of demand (see Figure 1, right-hand panel). This third effect represents a 'mark-up effect.'

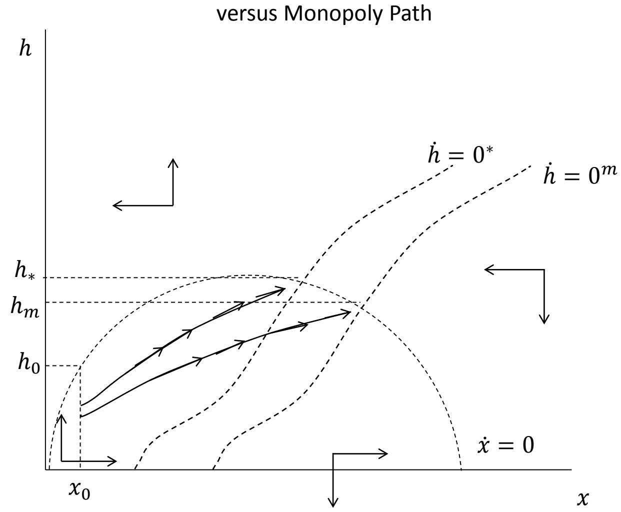
Figure 1 illustrates these movements graphically for the monopolist and the social planner. While the social planner only sees the shift in marginal costs from S_{OA} to S_{ss}, the monopolist also restricts production to further restrict the output price. S_0 represents the first period internalization of the stock externality while the fish stock remains at the rent dissipated level. Over time this curve moves down, but not necessarily below the rent dissipated curve. As drawn here, the monopolist restricts the harvest in the long-run below the rent dissipated level, despite higher fish population levels. In general, the steady-state levels depend on the form of the cost function and demand curve.

Using the maximum principles of both problems, the difference between price and marginal cost in the monopolist case reflects the marginal resource rent plus the monopoly mark-up. Therefore, the monopolist lowers the initial harvest level beyond the socially optimal level. As the stock recovers, the monopolist's harvest can exceed or be less than socially optimal.

Comparing necessary conditions also reveals that if the sector faces an infinitely elastic demand so that $p'(h) = 0$, the monopolist behaves like a social planner. This is because with a flat demand curve, the mark-up effect does not exist. It follows that as demand becomes more inelastic, the optimal and monopoly policies become increasingly different.

The phase plane below (Figure 2) illustrates example optimal paths for a social planner and monopolist, starting from the rent-dissipated fish stock. The optimal paths are the saddle paths from 2 distinct systems of ordinary differential equations plotted together for comparison. As illustrated, the monopolist steady state results in a higher harvest and lower output price than under rent dissipation. While still higher than the optimal price, the monopoly steady-state is preferred to rent dissipation. The monopolist increases rents by greatly decreasing costs instead of increasing price in the long-run. The cost occurs in the short-run from additional restriction of harvest while the fish stock remains low.

Figure 2: Phase Plane Comparison: Optimal versus Monopoly Path



Measuring the welfare impact of the monopolist compared to rent dissipation requires analyzing the relative magnitudes of the savings from the stock-cost effect and the increased price from the mark-up effect. Figures 3 and 4 illustrate how the formation of a monopoly can lead to a long-run per-period welfare improvement when compared to a rent dissipated fishery. In Figure 3, the upper graph shows a situation where there is a gain (stock-cost effect) and loss (mark-up effect) from monopoly formation, but the loss outweighs the gain. In the lower graph, the stock-cost effect dominates and this leads to a net gain from the monopoly.

Figure 3: Comparison of Rent Dissipation and Monopoly: Effect of Stock-Dependent Costs

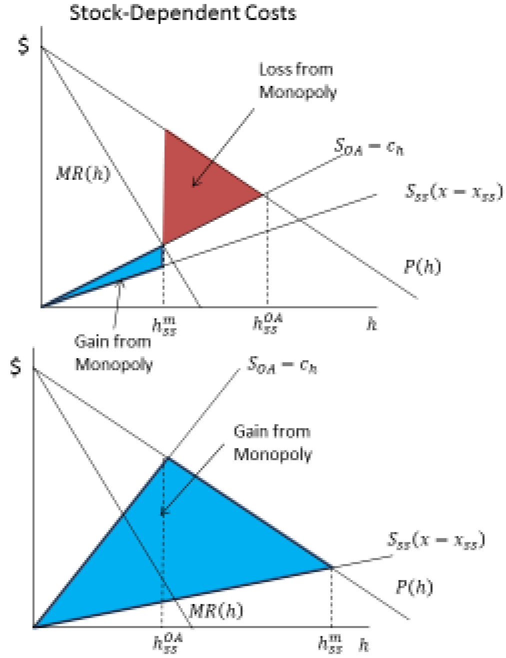
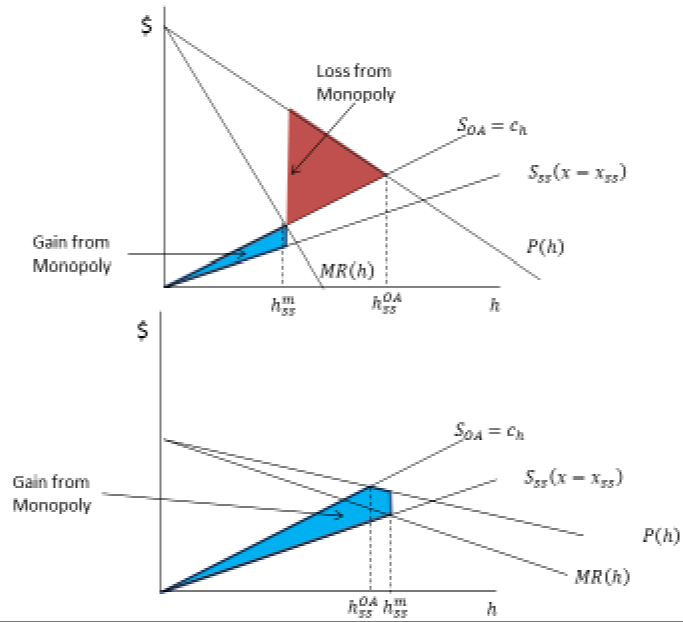


Figure 4 demonstrates that as demand becomes more elastic, this weakens the mark-up effect and the monopoly is more likely to be preferred to the rent dissipated outcome. If the monopolist harvest level exceeds the rent dissipated level, no cost appears graphically. This occurs because the mark-up effect introduces a cost relative to the optimal harvest level but not compared to the rent dissipated level. If rent dissipation is the alternative, both consumers and producers gain by the creation of the monopoly.

Figure 4: Comparison of open access and monopoly: effect of demand elasticity



A key consideration for evaluating the impact of monopoly power includes the time it takes for a monopolist to move close to the steady state. Because the monopolist decreases the harvest in the short-run, likely even more than the social planner, there may be a large deadweight loss in early periods while the fish stock recovers. In this case, even if the monopolist steady state is preferred to the rent-dissipated steady state, if it takes too long to get there, rent dissipation may still be preferred.

Comparing institutions

The first-best policy is the social planner's policy. In theory, this could be achieved through the use of centralized management institutions such as landings taxes or ITQs. In practice, the first-best outcome may not be politically feasible. In order to decide whether the monopoly or rent dissipation is preferred, we compare the value produced over time under the two institutions. To do this, we construct a measure of per-period welfare in the output market. Under rent dissipation, per-period welfare is:

$$W^{OA} = \int_0^{h^{OA}} (p(h) - c_h)\, dh$$

Where the fish stock is at a low level and so c_h is higher than it could be. Note that it does not include the dynamic cost of harvest. With the monopolist, per-period welfare is:

$$W^m = \int_0^{h^m} (p(h) - c_h) dh$$

Where c_h begins at the open access level but as the fish population recovers, falls through time. A comparison of the present value of the flow of welfare from the sector reveals the preferred institution. Specifically, a monopoly is preferred to rent dissipation of the planning horizon from 0 to T (given social discount rate, δ) if:

$$\int_0^T \left[\int_0^{h_t^m} (p(h) - c_{ht}) dh - \int_0^{h^{OA_t}} (p(h) - c_{ht})\, dh \right] e^{-\delta t} dt > 0$$

In practice, a discrete-time approximation can be used to compare, for example, annual welfare in the fish output market. This can be done by summing over time periods:

$$\sum_{t=0}^{T} \beta^t \left(\int_0^{h_t^m} (p(h) - c_{ht}) dh - \int_0^{h^{OA_t}} (p(h) - c_{ht}) \right) > 0$$

$$x_{t+1} - x_t = F(x_t) - h_t$$

Where $\dot{x}$ has been discretized to allow for inter-annual fish stock growth. β is the discount factor corresponding to the social discount rate. This condition reveals several factors that affect the socially preferred institution:

1. The bigger the welfare loss in the rent-dissipated fishery, the bigger the long-term gains to the monopoly. If the fish population is driven to very low (potentially unsustainable) population levels, the marginal cost of harvest could be very high and so the rent-dissipated harvest level is very low. The quicker the fish population recovers, the sooner these benefits will occur.
2. Less elastic demand leads to a larger loss from co-op market power. While this is true, a fishery with a downward sloping demand curve may still benefit from the formation of a co-op. Infinitely elastic demand is not a condition for the monopoly to be preferred.
3. Higher social discount rates favor rent dissipation because of the short-term losses caused by harvest reductions.
4. If marginal costs are sensitive to stock levels so that the monopolist's marginal cost is much lower, this favors the monopoly.

Overall, this model demonstrates that a harvester monopoly with exclusive use rights can be preferred to a rent dissipated fishery. US anti-trust law should consider this when investigating cases in which fishermen coordinate to limit catches. With a monopolist, the deviation of price from marginal cost is part monopoly rent and part resource rent. Monopoly rent decreases welfare but resource rent enhances it. Therefore, some use of market power may be socially preferred to a management institution under which fishery rent is dissipated.

3. Discussion

The theoretical results presented here demonstrate that fisheries co-ops with monopoly power can represent a social gain relative to an unmanaged fishery. Under some circumstances, a monopoly-managed fishery can have higher sustained harvest levels than the rent-dissipated levels. In this case, consumers *gain* as a result of the monopoly (although not compared to the optimal harvest levels). Even if the monopolist's steady state harvest is less than the rent-dissipated harvest, overall surplus can be greater if harvest-costs decrease significantly due to the internalization effect. Also, if a fishery faces an infinitely elastic demand, formation of a co-op necessarily represents an improvement over open access because the monopolist objective to maximize rent will only maximize resource rent. Even in the absence of monopoly power, a co-op would produce where price exceeds the marginal cost of harvest, but all the rent is resource rent.

In practice, many individual fisheries may not have significant market power because consumers easily substitute between fish from different species and regions. This is mainly true for frozen fish. However, local, fresh fish commands a price premium and likely gives producers some market power. This may be especially true for high quality fish products such as sushi and sashimi. The arrival of cheaper, farmed fish has also put pressure on wild-catch fisheries to differentiate and create higher-value products. In addition, many fishing communities are relatively isolated, creating local markets for fresh fish. Local prices likely depend on local harvest levels, creating the potential for market power if vessels work together.

The conventional deadweight loss from monopoly power forms as the monopolist does not want to give up infra-marginal profit to increase sales (the mark-up effect). In practice, when evaluating the impact of a monopoly in a fishery, this loss must be weighed against the gain in value from the creation of resource rent and the internalization of the dynamic stock-cost effect.

The results presented in this paper have several policy implications. Most obviously, outlawing fishery co-ops *ex ante* is not preferred from a social welfare perspective if the alternative is a rent dissipated fishery. Co-ops should be allowed to form if it can be demonstrated that the gains from cooperation exceed the cost of monopoly power. This is most likely the case in severely overexploited fisheries and when the fish product has many substitutes. The existence of substitutes limits the fishery's ability to exercise monopoly power. Detecting the use of market power in a fishery does not mean looking for a gap between price and the marginal cost of effort. Instead, market power consists of a mark-up beyond the dynamic opportunity cost of the resource. Some market power may be preferred to the classic race to fish that depletes valuable resource stocks, increases harvest costs, and dissipates fishery rents.

An important distinction made in this paper is the theoretical separation of monopoly rent and resource rent. While monopoly rent represents a price increase beyond marginal cost that creates a deadweight loss, resource rent merely represents a payment to a factor input equal to its dynamic opportunity cost. Like any other capital stock, the resource receives a rental rate. When a resource stock earns its true rental rate, each input earns its opportunity cost and no profit remains along the optimal harvest path. After considering the payment to the resource stock, a co-op with no monopoly power would set price equal to the full, dynamic cost. On the contrary, with monopoly power input earnings exceed their opportunity cost.

These findings may be relevant for many fisheries in both the developed and developing world where current institutions have not had success implementing rights-based fisheries management. In the developing world, groups of local fishermen may be better placed to internally enforce rules than to have an outside government agency impose the rules. The necessary first step for this type of management is to give a set of users exclusive use-rights to the fishery.

Another consideration includes the distribution of the gains that occur as a result of the monopolist. If the monopolist increases harvest in the long-run, both producers and consumers gain. On the other hand, if the monopoly harvest is less than the rent dissipated harvest, consumers may lose as the monopoly producer earns rent. If fish are an important source of protein for a relatively poor population, this could be especially significant.

An important caveat to this research is that we have assumed that a monopoly co-op's goal would be to maximize the total value of resource plus monopoly rent. In reality, a co-op may have a slightly different goal such as maximizing the rent per unit of effort. In this case, the co-op may restrict membership in order to share the rents among fewer users. This practice may decrease the preference for the monopoly co-op but could be avoided by requiring the co-op to incorporate all current fishermen with the option of buying out some members.

4. Conclusion

In this paper, we demonstrate the importance of accounting for the net change in welfare when moving from an open access institution to a fish harvester cooperative with monopoly power. Specifically, a monopoly co-op may create a gain relative to a rent dissipated fishery because of its internalization of the impact of harvesting on the fish stock. As the monopolist reduces harvest, the fish stock begins to recover and harvesting costs decrease. Therefore, a monopolist does not earn rent only by the price mark-up. Over time, resource rent is also generated by the decreased harvest cost. It is entirely possible that the monopoly harvest level exceeds the rent dissipated harvest over time, leaving both producers and consumers in the sector better off.

We therefore recommend that fish harvester co-ops that attempt to limit the number of fishermen in a fishery should not be *ex ante* illegal under US antitrust law. Fisheries represent a unique industry because the fish stock provides fishermen a free input, despite the scarcity of the fish. Without management, the fish stock itself is overused and becomes degraded over time. In a first-best world, harvest levels would be set to maximize the surplus in a fishery. In practice, market power may mean that fisheries managers restrict the harvest too far relative to optimal. Despite this, the management improves the fish stock and lowers harvesting costs for fishermen and can even result in higher output over time. Therefore, a co-op managed fishery with some market power may be preferred to a rent-dissipated fishery.

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