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FESTSCHRIFT FOR RAUL V. FABELLA

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ARTICLES IN THIS ISSUE

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PRE

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Festschrift for Raul V. Fabella

This special edition of the *Philippine Review of Economics* honors Dr. Raul V. Fabella in his 70th year and recognizes his invaluable contribution to the economics discipline and profession. This edition comprises 13 articles from his colleagues and several generations of former students inspired or mentored by Dr. Fabella who are themselves making their mark in economics. The broad spectrum of topics covered—agricultural economics, competition policy, contract theory, game theory, history of economic thought, international economics, issues in productivity, growth and development, monetary policy, political economy and rent-seeking, public economics, and the theory of teams—are issues that Dr. Fabella himself has written on or taught his students during his long, productive years as a Professor of Economics at the UP School of Economics, nurturing an "oasis of excellence" in his spheres of influence, as well as advocated as a roving academic in his later years, endeavoring to engage policymakers and the public in general, in pursuit of welfare-improving changes for a better Philippines.

The wide gamut of topics in this issue is a testament to Dr. Fabella's eclectic intellectual interests yet unwavering devotion to upholding a high standard of academic excellence. As his biographical sketch at the National Academy of Science and Technology summarizes:

> Fabella's very development as a scholar and intellectual leader presents numerous paradoxes: a classicist turned mathematical economist; a rational-choice theorist who derives material and metaphor from both history and physics; a solitary thinker who agonizes over pedagogy; a pure theorist immersed in policy-debate; an inherently shy, private man who must deal with crowds. His career displays to the fullest the range of issues – from the mathematical to the moral – that economists can and must confront if they are to attain to that "cool head and warm heart" that was Marshall's ideal. A classicist, however, might simply recall Terentius: *Homo sum: humani nil a me alienum puto*.

Indeed, to Dr. Fabella, nothing related to human behavior is outside his interest. At 70 years of age, National Scientist of the National Academy of Science and Technology (Philippines) and Professor Emeritus at the University of the Philippines, he is yet to reach the zenith of his intellectual verve: Fabella the economist is transfiguring into Fabella the social scientist – one to whom *homo economicus* is no longer the norm, but the exception in the vast complexity of human interactions in society. It is thus unlikely that this will be the last festschrift in his honor.

Sarah Lynne S. Daway-Ducanes
Emmanuel S. de Dios

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A note on cooperative hunting (Holmstrom and Fabella meet the Dumagat of Tanay)

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This paper examines social institutions and norms related to cooperative big game hunting by introducing these explicitly into the basic economic model used to analyze moral hazard in teams [Holmstrom 1982]. Features built into Holmstrom's basic model include effort to locate and acquire game, trophy taking and carcass sharing among members of a hunting party. The insights offered here are inspired by the norms of the Dumagat of Tanay in hunting, meat sharing and trophy taking. Among the Dumagat, the individual who acquires the game takes the head and the feet as trophy. The rest of the carcass is divided up along the lines described by Fabella's [1988] natural team sharing formula.

JEL classification: J23, J24
Keywords: team sharing, team productivity, teams

1. Introduction

This paper revisits the problem of moral hazard in teams by introducing observations and findings from anthropological studies of cooperative hunting by primitive hunting societies. The "hunting hypothesis" considers large game hunting as a catalyst of human evolution. Big game hunting is considered key in the development of tool use, language, sexual division of labor, norms for cooperation and sharing, and intelligence associated with a large brain (Lee and Devore [1968]; Aurdrey [1976]; Washburn and Lancaster [1968]). All these seem to suggest that hunting societies may have introduced institutions that resolve team inefficiency owing to moral hazard.

While big game hunting is considered a driver for cooperation and egalitarian food sharing, it is also viewed as a means to establish status or mating competition. The "show-off" hypothesis proposes that men hunt to gain social attention and mating benefits by sharing game (Hawkes [1991]; Gurven and Hill [2009]).

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Another key observation from studies of hunting societies is that while there are patterns and norms for community-wide distribution of big game acquired, there also exist precise rules and procedures for ascribing ownership of an animal to one person when many contribute to acquiring it (Dowling [1968]; Bahuchet [1990]).

This paper will explore social institutions and norms related to big game hunting and introduce them explicitly into the basic economics model used to analyze the moral hazard in teams [Holmstrom 1982]. Features built into Holmstrom's basic model include effort to locate and acquire game, trophy taking and carcass sharing among members of a hunting party. The insights offered here are inspired by the norms of the Dumagat of Tanay in hunting, meat sharing and trophy taking. Among the Dumagat, the individual who acquires the game takes the head and the feet as trophy. The rest of the carcass is divided up along the lines described by Fabella's natural team sharing formula [Fabella 1988].

2. Preliminaries

Consider a hunting party of $n > 2$ that sets out to locate and acquire a quarry or prey Q, where

$$\mathrm{Q} = \begin{cases} 1, \text{ with probability v} \\ 0, \text{ with probability (1 - v)} \end{cases}$$

Define the effort applied by the hunting party as $e = (e_1, \ldots, e_n)$. Let the probability that the quarry is located and acquired be a function of effort $v(e)$, where $v_i'(e) > 0$ and $v_i''(e) < 0$. But there is disutility associated with effort exerted by members of the hunting party, $\psi_i(e_i)$ where $\psi_i'(e_i) > 0$ and $\psi_i''(e_i) > 0$.

The hunting party, as a whole, is assumed to have maximized surplus $s = v(e) - \sum \psi_i(e_i)$, while individual members maximize $U_i = s_i v(e) - \psi_i(e_i)$ where $s_i > 0$ is the share of the the members of the acquired game, with $\sum s_i = 1$.

2.1. Holmstrom's result

Assuming an interior solution, maximization of the surplus from hunting gives

$$v_i'(e) = \psi_i'(e_i) \qquad \text{all } i, \quad (1)$$

where $v_i'(e) = \partial v / \partial e_i$ and $\psi_i'(e_i) = \mathrm{d}\psi_i / \mathrm{d}e_i$. First best thus requires that the marginal benefit from effort equals its marginal disutility. Let $e_i = e_i^*$ solve (1).

On the other hand, individual members of the hunting party maximize U_i, which gives

$$s_i v_i'(e) = \psi_i'(e_i). \qquad (2)$$

Let $\tilde{e}_i$ solve (2). A comparison of equations (1) and (2) plus the assumption that effort is unobserved reproduces Holmstrom's result, that is $\tilde{e}_i < e_i^*$.

2.2. Hunting and ownership of the game

Suppose that the hunter who acquires the game takes a portion of the game as a trophy. While total surplus for the team remains unaffected by trophy taking, the utility of the individual hunter now becomes

$$U_i = s_i v(e)(1-t_i) + k^i(e)t_i - \psi_i(e_i). \qquad (3)$$

The probability that hunter i kills the prey is a function $k^i(e)$ with $k_i'(e) = \partial k^i / \partial e_i > 0$ and $k_i''(e) < 0$. The portion going to the hunter who acquires the game is t_i.

Maximization of (3) gives

$$s_i(1-t_i)v_i'(e) + k_i'(e)t_i = \psi_i'(e_i), \qquad \text{all } i. \qquad (4)$$

The significance of establishing ownership of the carcass is established by letting $t_i = 1$, which reduces (4) to

$$k_i'(e) = \psi_i'(e_i). \qquad (5)$$

Let e_i^t solve (5). How does e_i^t compare with $\tilde{e}_i$ from (2)? The hunting game formulated in (3) essentially turns the moral hazard in teams problem into a "winner take all" game by setting $t_i = 1$. In effect e_i^t represents the bid to acquire the game and to be declared owner of the entire carcass. Since individual contribution to the hunt in (2) is unobserved unlike that of killing the game, $\tilde{e}_i < e_i^t$.

According to (5), by assigning ownership of the entire game to the hunter who acquires it, solves the moral hazard problem. After all, the acquisition of the game by an individual member of the hunting party is observable. Studies of hunting societies suggest that while the game is owned, it is nonetheless shared among the hunting party as a means of storing meat via the institution of reciprocity. Bushmen of the Kalahari Desert are highly mobile and do not have the physical means of storing meat. Sharing is a form of social insurance [Cashdan 1980].

Studies of hunting societies establish that the individual who kills or inflicts the first serious wound on the prey owns it. But it is emphasized that the rights and prerogatives entailed in ownership are primarily those of performing the distribution, not deciding whether or not the animal will be distributed. Ownership is primarily a prestige point and carries no exclusive rights over the disposal of the animal [Dowling 1968].

2.3. Trophy taking

The Dumagat of Tanay set aside the head and the feet as trophy for the hunter who kills the wild boar or deer[1]. The explanation offered is that it is the head of the animal that chooses which hunter should acquire it, and that it is the feet that approach the hunter so chosen. It is also worth noting that these parts of the animal clearly indicate size and age of the game, last long when displayed or worn, but have minimal meat content. The rest of the carcass is distributed among the members of the hunting party according to their primary roles either as tracker/shooter or bush beaters.

Following Dumagat custom, the utility of the individual hunter is modified to account for the trophy τ that does not diminish available meat to be shared by the hunting party,

$$U_i = s_i v(e) + k_i(e_i)\,\tau - \psi_i(e_i). \qquad (6)$$

Maximization of (6) gives

$$s_i v_i'(e) + k_i'(e_i)\,\tau = \psi_i'(e_i). \qquad (7)$$

Let e_i^{τ} solve (7). Comparing (7) with (2) and (1) suggests that $e_i \le e_i^{\tau} \le e_i^{*}$, depending on the marginal utility attached to the trophy. This interpretation of trophy taking allows for widespread meat sharing as well as the opportunity for successful hunters to "show off" their skill.

2.4. Meat sharing

The Dumagat of Tanay distribute acquired game according to the role individuals play in a hunting party. In a typical hunting party, there would be individuals primarily assigned as shooters, as trackers and dog handlers, and as beaters to drive out animals[2].

Typically, the shooter who acquires the game gets a quarter of the carcass in addition to the trophy parts. One half goes to the rest of the shooters and trackers, and the remaining quarter is shared among beaters. Interestingly, this sharing scheme is similar to that employed by Maya communities in Mexico [Rodriguez-Valencia and Cervera 2012].

[1*] Based on personal communications between Dumagat hunters and the author, who is grateful to have been given the privilege of observing hunting practices of Dumagat based in Tanay, Rizal.

[2**] One type of hunting is referred to locally as *batida* (from *batir*, Sp. "to beat") which is also practised among the Maya communities of Yucatan, Mexico [Rodriguez-Valencia and Cervera 2012]. This involves shooters, positioned where game is likely to appear, exit, or pass; trackers (and dog handlers) who locate the game or quarry; and bush beaters, who drive the game towards shooters. Trackers and dog handlers can be shooters, but bush beaters cannot, possibly for safety purposes. At the top of the totem pole are shooters (especially those who possess shotguns), followed by trackers, and then the beaters.

Individual effort levels may not be observable, but group effort as shooters vs. trackers vs. beaters are apparent. If the quarry is not located and tracked, time and effort of shooters and beaters will be wasted. If a game is located, beaters could fail to drive the prey to where shooters are positioned. Finally, animals may be located and effectively flushed but are then missed by shooters.

It can be argued that this sharing scheme is an implementation of the natural sharing scheme proposed by Fabella [1988]. Suppose there are only two types of members in a hunting party: shooters, and trackers and beaters with respective effort levels $e^1 = (e_i^{\,1} \ldots e_n^{\,1})$ and $e^2 = (e_1^{\,1} \ldots e_m^{\,1})$. In the cooperative hunting model, natural team sharing is defined as $s_i^{\,1} = E_1/nE$ for individual shooters, and $s_j^{\,2} = E_2/nE$ for individual trackers/beaters, where $E_1 = \sum_{i.} e_i^{\,1}$, $E_2 = \sum_{j.} e_j^{\,2}$ and $E = E_1 + E_2$.

Trophy taking aside, the Dumagat have rules to determine how much meat goes to shooters and to trackers/beaters. The allocation to shooters is divided equally among the number of shooters. Similarly, the allocation to trackers/beaters is divided equally among members of that group. This practice allows the analysis to focus on meat sharing between shooters and trackers/beaters.

Surplus for the entire hunting party is rewritten as

$$S = k(e^1)v(e^2) - \sum_i \psi_i^1(e_i^1) - \sum_j \psi_j^2(e_j^2)$$

where $k(e^1)$ is the probability that the game is acquired, which is a function of the effort level of shooters. The probability that the game is tracked and flushed, $v(e^2)$, is a function of the effort level of trackers and beaters.

Maximization of S with respect to the components of e^1 and e^2 gives the following first i order conditions:

$$k_i'(e^1)v(e^2) = \psi_i^{1\prime}(e_i^1) \qquad \text{all } i \quad (8)$$

$$k(e^1)v_j'(e^2) = \psi_j^{2\prime}(e_j^2) \qquad \text{all } j. \quad (9)$$

In order to focus the analysis on meat sharing, trophy taking is ignored in this section. The utility of shooters and of trackers can be written respectively as follows:

$$U_i^{\,1} = (E_1/nE)k(e^1)v - \psi_i^1(e_i^{\,1})$$

$$U_j^{\,2} = (E_2/nE)kv(e^2) - \psi_j^2(e_j^{\,2}).$$

Maximization of the utility of shooters and of trackers gives the following conditions:

$$(E_2/nE^2)kv + (E_1/nE)k_i'(e^1)v = \psi_i^{\,1\prime}(e_i^{\,1}) \qquad \text{all } i \quad (10)$$

$$(E_1/mE^2)kv + (E_2/mE)kv_j'(e^2) = \psi_j^{\,2\prime}(e_j^{\,2}) \qquad \text{all } j. \quad (11)$$

Following Fabella [1988], assume that

$$kv = k_i'(e^1)vE = v_j'(e^2)kE. \qquad (12)$$

This assumption implies that the expected game meat is equal to the marginal contribution of shooters times the probability that the game is tracked times the sum of the effort of both parties. Similarly, the expected game meat is also equal to the marginal contribution of trackers times the probability that the game is acquired by shooters times total effort.

Applying the relevant portions of (12) on (10) and (11) generates the following:

$$vk_i'(e^1)/n = \psi_i^{1\prime}(e_i^1) \qquad \text{all } i \quad (13)$$

$$kv_j'(e^2)/m = \psi_j^{2\prime}(e_j^2) \qquad \text{all } j. \quad (14)$$

In a hunt, the success or failure of shooters, and of trackers/beaters is observable. The Dumagat use this to devise a two-step sharing process: (1) the share of shooters vs. trackers based on observed team effort; and (2) equal sharing among shooters, and among trackers. The application of Fabella (1988) generates a version of the Dumagat rule in equations (13) and (14). A comparison of (10) and (11) with (13) and (14), respectively, given that $\psi_i'(e_i) > 0$ and $\psi_i''(e_i) > 0$, leads to the conclusion that effort levels are higher under (13) and (14).

3. Concluding remarks

Institutions or mechanisms that seem to have sustained hunting societies were explicitly introduced here into a model of cooperative hunting based on Holmstrom's construction. Three interrelated mechanisms were specifically analyzed: (1) the separation between ownership of the quarry and meat-sharing; (2) trophy taking; and (3) meat distribution of the game according to one's role in the hunt. Under certain conditions, these institutions or mechanisms have been shown to mitigate the effects of moral hazard at least in the context of cooperative hunting.

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