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AGGREGATION OF VEBLEN EFFECTS AND MULTIOBJECTIVE PROGRAMMING: AN APPLICATION TO AGRICULTURE

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ABSTRACT

In this paper, after theoretical extension of Veblen's theory of conspicuous consumption to production process, three methods were introduced for aggregating Veblen effects and multiobjective programming. They are: (1) using iterative weighting method to aggregate Veblen effects and multiobjective programming, (2) the social status coefficients are estimated subjectively and (3) a new objective is introduced as an index of social status. The third method was applied to a sample of Rafsanjan pistachio growers. The farmers yield was considered as the social status index. The results showed that farmers choose neither profit maximization goal nor yield maximization goal, but choose a compromise between these two objectives. Thus, trying to increase social status can be considered as one of the important objectives of the farmers. This objective influences both objective space and decision space. In the objective space a compromise between social status goal and other objectives is considered. This compromising would also change the decisions space.

Key words: Multiobjective programming, Utility, Veblen effects.

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ترکیب اثرهای وبلن و برنامه ریزی چند هدفی : کاربرد در کشاورزی

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چکیده

در این مقاله ، پس از بسط نظری " تئوری مصرف وبلن " به فرایند تولید، سه روش برای ترکیب اثرهای وبلن و برنامه ریزی چند هدفی معرفی شده است. این روش ها عبارتند از ۱) استفاده از روش وزنی تکراری برای ترکیب برنامه ریزی چند هدفی و اثرهای وبلن، ۲) تخمین ذهنی ضرایب منزلت اجتماعی و ۳) معرفی هدفی جدید به عنوان شاخصی از منزلت اجتماعی. با استفاده از نمونه ای از پسته کاران شهرستان رفسنجان، روش سوم مورد استفاده قرار گرفت. عملکرد در هکتار زارعین به عنوان شاخصی از منزلت اجتماعی منظور شد. نتایج نشان داد که کشاورزان هیچکدام از هدف های حداکثر سازی سود و حداکثر سازی عملکرد محصول را به تنهایی انتخاب نمی کنند. آنان بین این دو هدف، مصالحه ای ایجاد می کنند. بنابراین، کشاورزان تلاش برای افزایش منزلت اجتماعی (در کنار دیگرهدف ها) را مهم می دانند. این هدف جدید بر فضاهای تصمیم و هدف اثر می‌گذارد. در فضای هدف، مصالحه‌ای بین هدف منزلت اجتماعی و دیگر هدف های ایجاد شده و این مصالحه، فضای تصمیم را تغییر می دهد.

INTRODUCTION

The ongoing transformation in many public policy areas from decision making based upon traditional planning models featuring a single objective to multiobjective analysis has promoted a field of mathematical programming called vector optimization (6, 17, 26, 31). This is defined as the generation of a set of non-inferior solutions to the problems and do not require an articulation of preferences among goals by decision maker (5, 8, 21, 24, 27). The remaining techniques do require a prior (7, 10, 12, 16, 22), or a sequential (19, 23, 32), articulation of preferences, with the result being a single optimum solution rather than a set of non-inferior solutions.

Long ago, Veblen (28) put forward an explanatory theory of the utility of commodities that attempts to account for the formation and change of consumer preferences over time. Briefly, utility is a property of the acts of purchasing, owning or controlling, and consuming commodities (4, 30). Actually, the utility of commodities is viewed as a result of two kinds of utilities that compete with each other in affecting the consumer·s responses to changes in prices consumers must pay and to the consumer's abilities to pay.

In the present connection it must be emphasized that Veblen (29) considered this secondary utility of commodities to be pervasive rather than confined to a few unusual commodities. According to Veblen's theory, conspicuous consumption, or the consumption of goods and services that is motivated predominantly by secondary utility, is not confined to the leisure class but prevails over all the social and income classes from richest to poorest. The less affluent classes emulate the consumption patterns of the more affluent. Finally, secondary utility is not weak relative to primary utility and has far-reaching consequences for economic growth and change (3, 9).

Despite its importance, a few economists followed Veblen's theory. Also, regardless of Veblen discussion about productive goods, his theory has been expanded, only, in consumption of goods. The major contributions to Veblen theory of conspicuous consumption came to the work of Hamilton (13), Mason (18), Basmann *et al.* (3), Leibenstein (15), Jennings and Waller

(14), Frank (9), Pollak (20), Bagwell and Bernheim (2). Haight (11) also contributed to Veblen theory in production field.

The purpose of this study was to enter Veblen effects as a new objective into multiobjective programming. At first, Veblen effects and its aggregation with multiobjective programming were theoretically discussed. Then using a sample of Rafsanjan pistachio producers, it was applied to agriculture.

MATERIALS AND METHODS

Theoretical framework of this study is divided into three sections a) Veblen's theory of conspicuous consumption; b) extension of conspicuous consumption to production process and c) aggregation of multiobjective programming and veblen effects.

Veblen's Theory of Conspicuous Consumption

In his celebrated treatise on the "leisure class", Veblen (28) argued that wealthy individuals often consume highly conspicuous goods and services in order to advertise their wealth, thereby achieving greater social status. Veblen's writings have spawned a significant body of research on "prestige" or "status" goods.

The details of Veblen's arguments naturally invite the interpretation that conspicuous consumption reflects signaling. In particular, Veblen distinguished between two motives for consuming conspicuous goods: "invidious comparison" and "pecuniary emulation". Invidious comparison refers to situations in which a member of a higher class consumes conspicuously to distinguish himself from members of a lower class. Pecuniary emulation occurs when a member of a lower class consumes conspicuously so that he will be thought of as a member of a higher class. In modern terms, these motives are the essence of the incentive compatibility conditions that form the basis for signaling. Members of higher classes voluntarily incur costs to differentiate themselves from members of lower classes (invidious comparison), knowing that these costs must be large enough to discourage imitation (pecuniary emulation).

Bagwell and Bernheim (2) might have been the only persons who have explained Veblen effects through a mathematical framework. Their model does not constrain consumers to signal wealth by overpaying for visibly labeled conspicuous goods. It is also possible to signal by consuming large quantities of the good at a lower price, and/or by selecting higher quality. Thus, to the extent Veblen effects are present, they must be generated endogenously.

Bagwell and Bernheim (2) showed that Veblen effects do not arise when the model satisfies the standard "single-crossing", which in this context states that the marginal cost of consuming the conspicuous good is higher for individuals with lower wealth, so that the indifference curves of consumers with different levels of wealth cross at most once. However, when the single-crossing property fails in a particular way, and preferences satisfy a "tangency property", Veblen effects may emerge. They also, after introducing some examples, showed that "tangency property" is a common property and so Veblen effects are important in real world.

The simple form of Bagwell and Bernheim model can be written as follow. Consider a household that must allocate resources over two types of consumption goods. One type is "conspicuous", in the sense that its characteristics, as well as the quantity consumed, are publicly observed. The characteristics of the conspicuous good include quality, q, where q $[q,\overline{q}]$. The second type of good is "inconspicuous", in the sense that it is consumed privately, and not observed by others. Because of assumptions about observability, only conspicuous consumption can potentially serve as a signal of wealth. The inconspicuous good is assumed, for simplicity, to be of fixed quality.

Each household cares about its total quality-weighted conspicuous consumption, defined as (25):

$$x=\int_{q}^{\overline{q}} \mu(q)x(q)dq, \qquad [1]$$

where $\mu(q)$ are weighting parameters (common to all households), assumed to be increasing in q. It is assumed that households care about: (a) consumption of the inconspicuous good, z, and (b) an action ρ taken by the representative social contact. Total utility function is given by U(x, z, ρ).

It is assumed that U is strictly increasing and continuous in each of its arguments.

The game unfolds as follows. First, consumers observe all announced quality levels and prices, and determine the amount of conspicuous good to be purchased from each firm. Residual resources are used for inconspicuous consumption, z. Second, social contacts observe each household's branded conspicuous consumption bundles, from inferences about each household's wealth and react accordingly (by choosing p). The payoff to each household is given by U_i(x, z, p). Social contacts receive payoff of $\varnothing(R,\rho)$ where R is the household's actual resources. Firm's payoffs are given by profits.

Extension of Conspicuous Consumption to Production Process

By consideration of risk and uncertainty in production process, the profit maximization goal was replaced by utility maximization. It has been proved that profit is not the only goal for producers. They usually prefer to maximize their utility resulting from production process. The use of utility theory is based on the theorem of expected utility. Bernoulli (4) proposed a substitute for the criterion of expected monetary gain for making optimal choices. This substitute is called the expected utility or moral expectation. But he did not suggest a method to measure utility. All the same, he is credited with the insight leading to the development of modern theory of utility. Working with the foundations provided by von Neuman and Morgenstern (30).

For extension of conspicuous consumption to production process, the expected value of the von Neumann-Morgenstern utility function, U, is considered as the farmer's objective function. The general form of the utility function is U (π, ρ) where π is the farmer's profit, and ρ is the social contanct. Let the farmer's profit, π, be a function of a random variable, ε, such as random output price risk, yield risk, input price risk, and a profit factor, α, that may respect the level of ou-put, input choice, position in the future market, etc. Thus the utility function can be written as follows:

$$U=U(\varepsilon, \alpha, \rho) \quad [2]$$

α can be divided into two kinds of inputs. Input which is used as a conspicuous factor (x), and input which is used for increasing physical products (z). Conspicuous factor is used because: 1) using conspicuous factor, such as new inputs and technology, by itself increases social status, and 2) using conspicuous factor more than enough, yield increases, thereby achieving greater social status. Social contacts observe each producer's branded conspicuous factors and yield bundles and react accordingly by choosing. So, the final utility function can be written as follow:

$$U=U(\varepsilon, \chi, Z, \rho) \quad [3]$$

In other words, like consumers, producers, using conspicuous factors, increase their social status.

Aggregation of Veblen Effects and Multiobjective Programming

For aggregating Veblen effects and multiobjective programming, three methods are introduced.

In the first method, using iterative weighting, Veblen effects and MOP are corporated. The differences between corporated iterative weighting method and ordinary one is only in weights. In new method, weights are based on the degree of social status that is established by each goal. In other words, the objective which creates higher social status will be given higher weight. The social status weights are determined by progressive articulation of preferences.

In the second method, like risk averse coefficients, social status coefficients can be estimated for every one. These coefficients are estimated subjectivøly. For example, asking respondent the following questions the coefficients can be determined. 1) Will you invest in project x (the name of the project)? If no, interview stops, if yes, go to question number 2; 2) How much will you invest in project x ? ; 3) All your colleagues who have been asked, have said twofold your answer, don't you change your answer? If the respondent did change his answer, It can be concluded that he decides regardless of the others, his social status coefficient is zero. If he changes his answer, he decides following the others. Here, paying attention to the first answer and its change, the social status coefficient of respondent can be calculated. The coefficients can be used just similar to risk averse coefficients.

The third method which was used in the current study is easier than the others. Here, a new objective is introduced as an index of social status. Among all objectives, the one which is socially the most important, is considered as social status objective. For example, as used in the current study, compared to profit goal, the yield objective is considered as an index of social status, because the success of a farmer is usually judged based on his yield. The farmer whose yield is the highest is usually considered as the first best producer. Then, similar to ordinary multiobjective programming will be acted.

The Model

The objective function of linear programming model is a piecewise linear function. The critical assumptions underlying the model are the following: 1) the process of agricultural production can be divided into separate and independent activities; 2) each production activity is characterized by constant returns to scale (efficiency as a function of size) and fixed proportions among inputs; 3) fractions of activities can be used. The following are symbols used in the model:

Z: Total profit, defined as net returns to land and management.

π: Profit per ha of each activity (in Rials).

X: Acreage for each activity.

P: Price per m^3 of water delivered to the farm (in Rials).

I: Irrigation intensity (m^3 water ha^{-1})

The following subscripts are used in the model:

i: Irrigation intensity (m^3)

j: Salinity (millimhos cm^{-1})

k: Soil type

l: Age of pistachio trees

Table 1 shows the summary of subscripts.

The model is set as follows: maximize the objective function:

$$Z = \sum (\pi_{ijkl} - P.I_{ijkl})X_{ijkl} \quad [4]$$

subject to:

$$\sum I_{ijkl}.X_{ijkl} \le b_j \qquad j=1, 2, \dots \quad [5]$$

$$\sum X_{ijkl} \le b_k, \qquad k= 1, 2, \dots \quad [6]$$

$$\sum X_{ijkl} \le b_l \qquad l= 1, 2, \dots \quad [7]$$

where equations 5-7 are water, land and the age of pistachio trees constraints, respectively.

Table 1. Characteristics of the subscripts.

	Subscripts number				
Subscripts name	1	2	3	4	5
i	1000-5000	5000-10000	10000-15000	15000-20000	>20000
j	0-5	5-10	10-15	15-20	-
k	Stone-sand	Sand	Clay	Sand-clay	-
l	<10	>10	-	-	-

Farm level data were collected from a sample of 100 farmers who were selected by a two stage cluster sampling from Rafsanjan district, Kerman province, Iran. First, a cluster of 20 villages was selected. Second, 5 farmers were chosen randomly from each village. Data were then collected using designed questionnaires.

RESULTS AND DISCUSSION

Among three methods introduced for aggregating Veblen effects and MOP, the third one was chosen. Yield was selected as an index of social status. As mentioned, the farmer who has the highest yield is usually known as the first best farmer. So farmers try, regardless of the cost, to increase their farm yield. Thus, here, there are two objectives, maximizing profit and maximizing yield.

A device frequently used within MOP approach is the payoff matrix. The elements of this matrix are obtained by optimizing the objectives under consideration and then computing their value in each one of the optimal solutions. The payoff matrix is very useful to illustrate the degree of conflict between the objectives under consideration. Data in Table 2 show the payoff matrix for those objectives. The elements of that matrix are easy to understand. For example, the elements in the first row mean that to maximum profit (8833000 Rials ha^{-1}) corresponds a yield of 1281 kg ha^{-1}

From Table 2 it is easy to investigate the degree of conflict between the two objectives. Thus, profit conflicts with yield to some extent. The elements in the main diagonal of the payoff matrix established the ideal point; that is, the point where all the objectives achieve their optimum value. In this problem the ideal point is 8833000 Rials ha^{-1} for profit, and 1300 kg ha^{-1} for yield. However, the ideal point is unfeasible because the objectives are in conflict. The points of maximum profit and maximum yield are considered the bounds of a transformation curve which measures the relationship between objectives. Generating this curve indicates the trade-off between the objectives being considered. This trade-off can be characterized as the opportunity cost of yield in terms of profit and vice versa. Under a computational point of view, the establishment of the transformation curve is equivalent to the generation of the set of efficient or pareto -optimal solutions.

Table 2. Payoff matrix for profit and yield objectives.

	Profit (Rials ha^{-1})	Yield (kg ha^{-1})
Profit	8833000	1281
Yield	8452000	1300

Among different techniques to generate the efficient set, constraint method was chosen. The resulting trade-off curve or efficient set for this pair of objectives is shown in Fig. 1. The actual values of the trade-offs (i.e., the opportunity costs) between profit-yield is presented by the slopes of the straight lines connecting the extreme efficient points is shown in Fig. 1. For example, slope of the first segment in Fig. 1 indicates that in this part of the trade off curve each kg ha^{-1} increase in yield decreases

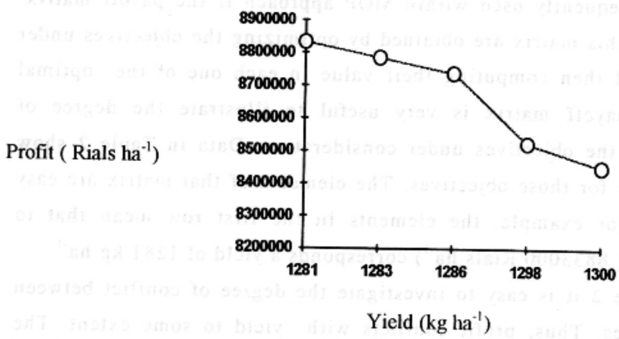

Fig. 1. Trade-off curve for the profit and yield objectives.

profit by 24000 Rials ha^{-1}. Thus, the opportunity cost of one kg ha^{-1} increase in yield and so the increase of farmer social status can be measured as a loss of 24000 Rials ha^{-1} of profit.

To go a further step in this search, using constraint method, efficient set was established. Table 3 shows the cluster of efficient points in the objective and the decision space. The current case is added at the bottom of Table 3.

A measure of the trade-off between the two objectives can be obtained from the information contained in Table 3. For increasing yield in order to enhance social status, the farmers must lose some profits. If yield increases from 1281 (solution 1) to 1300 (solution 5), the profit will decrease from 8833000 to 8549000. The last column shows that when yield increases, the variable costs also increase. In other words, for increasing social status by having higher yield, farmers increase variable costs and in turn, profit will decrease. So higher social status can be achieved at the expense of lower profit.

Also, decision variables show that to increase yield, farmers have to choose the activities which need more water. For example, the answer to variable X_{5142} in which irrigation intensity is greater than 20000 m^3 ha^{-1}, is zero for solution 1 but 6989 ha for solution 5.

Results indicated that, among 5 efficient points, case 3 is the nearest one to the current case. Thus, trying to increase social status can be considered as an important objective by farmers. This new objective influences both objective space and decision space. In objective space a compromise between social status goal and other objectives is considered. This compromise changes the decision space too.

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Table 3. Cluster of efficient points and cropping patterns for profit and yield objectives.

Efficient points	Objective functions		Decision variables (ha)†							
	Profit (Rials ha^{-1})	Yield (kg ha^{-1})	X_{1112}	X_{1142}	X_{2122}	X_{2132}	X_{3232}	X_{4142}	X_{5142}	Variable costs (Rials ha^{-1})
1	8833000	1281	4620	2120	3360	17395	4865	9640	0	3977000
2	8785000	1283	4620	2494	3360	17395	4865	8278	988	4045000
3	8738000	1286	4620	2826	3360	17395	4865	7070	1864	4122000
4	8524000	1298	4620	4488	3360	17395	4865	1028	6244	4456000
5	8452000	1300	4620	4771	3360	17395	4865	0	6989	4548000
Current case	8549000	1287	4620	2820	3360	17395	4865	7070	1870	4251000

† Variables are defined in the text.

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