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On fair allocations

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Abstract

This paper examines the effects of fairness on economic behavior and allocations, where fairness is defined as the absence of envy among consumers. We use the benefit function to investigate the welfare cost of fairness. We show how fairness generates a form of altruism, captured by a "fair expenditure" function that depends on the distribution of welfare. We define the most efficient fair allocations and explore the implications of fairness for economic behavior, pricing and redistribution policies.

JEL classification: D3; D5; D6

Keywords: Fairness; Efficiency; Altruism; Distribution

1. Introduction

There is strong evidence that equity and fairness are important aspects of economic behavior (e.g., Rabin, 1993; Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999; Konow, 2003). As a result, there is a continuing debate on how to introduce equity considerations in economic analysis. This paper focuses on fairness. Following Foley (1967), Kolm (1971), Feldman and Kirman (1974), Varian (1974), Chaudhuri (1986), Diamantaras and Thomson (1990), Nishimura (2003a,b) and others, we define fairness to mean the *absence of envy*: an allocation is fair if no individual prefers what another has to what he/she has. Intuitively, fairness depends on individual tastes and endowments. A number of fairness results have appeared in the literature. First, Kolm has found conditions where fairness and Pareto efficiency can coexist. Second, Feldman and Kirman have shown that competitive trade does not necessarily preserve fairness. Third, there are situations where Pareto efficiency and fairness are inconsistent with each other (Pazner and Schmeidler, 1974), suggesting the need to confront the trade-off between fairness and efficiency. While there is considerable evidence that market globalization has stimulated economic growth around the world, there remains questions about the distribution of its economic benefits (e.g., Bhagwati and Hudec, 1996, Stiglitz, 2003). Also, concerns have been raised about the fairness of particular markets (e.g., the coffee market). At this point, the relationships between fairness, efficiency, and market allocation remain poorly developed.

The objective of this paper is to investigate the implications of fairness for efficiency, economic behavior, pricing, and redistribution policies. The analysis relies on Luenberger's benefit function (Luenberger, 1992b), which provides a framework to examine the linkages between fairness and efficiency. This differs from the envy measure proposed

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by Chaudhuri (1986) and used by Diamantaras and Thomson (1990), and Nishimura (2003a,b). We develop a general economic analysis of possible trade-off between fairness and efficiency. We propose a simple measure of the welfare cost of fairness. In contrast with the Chaudhuri measure, our measure has the advantage of being additive, which is particularly convenient dealing with aggregation across individuals. In situations where fairness and efficiency can coexist, this welfare cost is zero. However, in situations where they conflict, this welfare cost is positive: it measures the extent of the inward shift in the Pareto utility frontier due to the imposition of fairness constraints.

We show that profit maximization remains relevant under fairness. Since profit maximization is about "making the pie as large as possible" while fairness is about "dividing the pie", equity concerns should not be addressed through taxation or subsidies of business firms. Under competitive markets, this indicates that introducing fairness considerations does not conflict with the decentralization of production decisions. We also investigate the implications of fairness for consumption behavior and consumer welfare. On the one hand, competitive markets may be consistent with fairness when the distribution of purchasing power among consumers is "not too unequal" (the welfare cost of fairness then being zero). On the other hand, competitive markets can fail to generate a fair allocation (e.g., when the distribution of purchasing power among consumers is very unequal). Then, the welfare cost of fairness is positive. In this context, we show how binding fairness constraints generates a form of altruism captured by a new "fair expenditure function" that depends on the welfare level of other agents. We analyze the general properties of this fair expenditure function. For example, we establish that the classical consumer expenditure function is a lower bound on the fair expenditure function. This means that the difference between these two expenditure functions provides a measure of the cost of fairness at the consumer level. In addition, binding fairness constraints mean that consumption decisions depend on others' welfare. This dependency implies that allocating consumer goods under binding fairness cannot be completely decentralized (in contrast with standard competitive markets). This inability to decentralize increases the information requirement necessary to support fair consumption decisions, creating a significant challenge to the implementation of fair allocations. We discuss the implications of our analysis for the design and implementation of redistribution policies to provide new and useful insights about the linkages and trade-off between efficiency and equity issues.

2. Preliminaries

Consider a set of consumers $N = \{1, 2, \ldots, n\}$ involved in the allocation of m commodities. For the ith consumer, denote by $w_i \in R_+^{\mathrm{m}}$ his/her initial endowment of the m commodities, and by $y_i \in R_+^{\mathrm{m}}$ the m-vector of quantities consumed, $i \in N$. Denote by $x \in X \subset R^{\mathrm{m}}$ the m-vector of aggregate netputs (corresponding to outputs when positive, and inputs when negative), where the set X represents the production technology.[1] We assume that the set X is closed. Letting $y = (y_1, y_2, \ldots, y_n)$, an allocation (x, y) is *feasible* if it satisfies $x \in X$, $y \in R_+^{\mathrm{nm}}$, and

$$\sum_{i \in N} y_i \leq x + \sum_{i \in N} w_i. \tag{1}$$

Eq. (1) states that aggregate consumption cannot exceed production plus initial endowments. Throughout, we assume that the set $[R_+^{\mathrm{m}} \cap (X + \sum_{i \in N} w_i)]$ has a non-empty interior.

Each consumer has preferences represented by a utility function $U_i(y_i)$, where U_i: $R_+^{\mathrm{m}} \to R$, $i \in N$. We assume that the utility functions $\mathrm{U_i}(y_i)$ are continuous and quasi-concave. It will be convenient to evaluate consumer welfare using Luenberger's benefit function. The benefit function relies on a reference commodity bundle $g \in R_+^{\mathrm{m}}$, $g \neq 0$. Throughout, we assume that g is a "good" (i.e. a bundle satisfying $U_i(y + \alpha g) > U_i(y)$ for all $y \in R_+^{\mathrm{m}}$, all $\alpha > 0$ and all consumers $i \in N$). Following Luenberger (1992b), the *benefit function* of the ith consumer is

$$b_i(y_i, u_i) = \max_{\beta}\{\beta : U_i(y_i - \beta g) \geq u_i, (y_i - \beta g) \in R_+^m\} \text{ if a feasible } \beta \text{ exists and } = -\infty \text{ otherwise.} \tag{2}$$

The benefit function measures the number of units of the reference bundle g the ith consumer is willing to give up to reach the consumption vector y_i starting from utility level u_i. As shown by Luenberger (1992b), under the assumptions

[1] The situation where there are multiple firms involved in production activities is a special case. For example, if there are K firms involved in the production process, denote by X_k the technology facing the k-th firm, $k = 1, \ldots, K$. Then, the aggregate netput vector is $x = \sum_{k=1}^{K} x_k$, where x_k is the netput vector of the k-th firm, $x_k \in X_k$, and $X = \sum_{k=1}^{K} X_k$.