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Efficiency of competitive equilibria in economies with time-dependent preferences

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Abstract

This paper focuses on welfare properties of equilibria in exchange economies with time-dependent preferences. We reintroduce the notion of time-consistent overall Pareto efficiency proposed by Herings and Rohde (2006) and show that, whenever all agents in the economy are sophisticated, any equilibrium allocation is efficient in this sense. Therefore, we present a version of the First Fundamental Welfare Theorem for this class of economies.

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1. Introduction

Consider an exchange economy consisting of consumers endowed with time-dependent preferences. As in Strotz (1955), each period an agent is represented by a different *self* whose preferences are defined over sequences of consumption bundles from the current period till the end of time. Since tastes may differ across dates, each consumer is characterised by a sequence of preference relations of his subsequent selves. If a credible commitment device is not available, each period the current self needs to take into account the behaviour of his future incarnations

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while choosing his consumption, since any plan determined in the current period may be revised by one of his future selves. Assuming that agents are sophisticated, that is, they can correctly predict changes in the preferences of their subsequent incarnations, the demand is determined by an outcome of the game between different selves of an individual consumer.[1]

Suppose that we allow the agents to trade. Every period the current selves may exchange their rights to consumption inherited from the preceding period for a different consumption plan which is affordable, given the current prices. In this paper we characterise welfare properties of equilibrium allocations arising in this class of economies.

We reintroduce the notion of *time-consistent overall Pareto efficiency* proposed by Herings and Rohde (2006, Definition 27). According to the definition, an allocation path is efficient if, at any time t, there is no other feasible allocation path which improves upon the initial one with respect to preferences of all the current and future selves following period t. In the main result of this paper we show that any competitive equilibrium allocation is efficient in this sense. Therefore, we present a version of the First Fundamental Welfare Theorem for economies with time-variant preferences.

Our discussion concentrates on economies with a *complete* market structure. Each period the current selves may freely exchange their goods and rights to future consumption on the spot and futures markets respectively, as long as their budget constraints are satisfied. In particular, this enables a strategic interaction between the current self and the subsequent incarnation of the consumer. Finally, given that the agents are sophisticated, we expect that, in equilibrium, the chosen consumption streams are time-consistent, i.e., none of the incarnations can strictly benefit from altering the plan.

Our result is related to the one obtained by Herings and Rohde (2006, Theorem 30). In the paper the authors discuss a class of exchange economies with *incomplete* markets and show that, in their framework, any equilibrium allocation path is time-consistently overall Pareto efficient. In their specification of the market, the agents are *not* allowed to transfer their wealth across time; rather, each period t, every agent is restricted to consuming only those bundles whose value does not exceed the value of his initial endowment of goods in that period. This removes the agent's ability to save or borrow, and rules out a channel of strategic interaction between different selves of the agent. The complete market structure we employ allows for this form of interaction.

This paper also refers to a different strand of the literature that focuses on conditions under which equilibrium allocations are efficient with respect to preferences of consumers in the initial period *only*. We will say that such allocations are *date-1 Pareto efficient*.[2] For example, Laibson (1997) has shown that once agents have access to illiquid financial instruments, they are able to commit their future incarnations to a plan which is optimal with respect to the individual preferences of the initial selves. Once we allow the agents to trade in this framework, the resulting equilibrium allocations are date-1 Pareto efficient.

Interestingly, in some special cases, even when individual agents are unable to commit, equilibrium allocations are date-1 Pareto efficient. This property was observed by Barro (1999) for production economies with consumers endowed with time-separable, logarithmic preferences, and hyperbolic discounting. The result is surprising, since it implies that even though the initial

[1] Our use of the term *sophisticated* follows, e.g., Pollak (1968).

[2] Our use of this term follows Luttmer and Mariotti (2007, Definition 1(i)). On the other hand, Herings and Rohde (2006, Definition 10) simply call such allocations *Pareto efficient*. It is worth pointing out that date-1 Pareto efficiency and time-consistent overall Pareto efficiency are not comparable. We discuss the differences between these two notions in Section 3.2.