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## Testable implications of general equilibrium theory: a differentiable approach

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### Abstract

Is general equilibrium theory empirically testable? Our perspective on this question differs from the standard, Sonnenschein–Debreu–Mantel (SDM) viewpoint. While the SDM tradition considers aggregate (excess) demand as a function of prices, we suppose that what is observable is the equilibrium price vector as a function of the fundamentals of the economy. We apply this perspective to an exchange economy where equilibrium prices and individual endowments are observable. We derive necessary and sufficient conditions that characterize the equilibrium prices, as functions of initial endowments. Furthermore, we show that, if these conditions are satisfied, then the economy can generically be identified. Finally, we show that when only aggregate data are available, observable restrictions vanish. We conclude that the availability of individual data is essential for the derivation of testable consequences of the general equilibrium construct.

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### 1. Introduction

Is general equilibrium theory empirically testable? This question has attracted considerable attention for at least 30 years; that is, at least since the statement of the “Sonnenschein

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problems". In two seminal papers, Sonnenschein (Sonnenschein, 1973, 1974) posed the question whether the individualistic foundations of general equilibrium theory could generate non-trivial testable restrictions on the aggregate excess demand or market demand functions of an exchange economy. The case of excess demand was solved by Mantel (1974) and Debreu (1974); the market demand problem was solved by Andreu (1983) for finite sets of data, and, recently, by Chiappori and Ekeland (1999a) for analytic demand functions. In all cases, the answer is negative, provided there are enough individuals in the economy—a conclusion that confirmed Sonnenschein's intuition and initial arguments.

These (by now classical) results have been widely interpreted as pointing out a severe weakness of general equilibrium theory, namely its inability to generate empirically falsifiable predictions. A prominent illustration of this stand is provided for instance by Kenneth Arrow, who, in a recent survey, listed among the main developments of utility theory the result that *in the aggregate, the hypothesis of rational behavior has in general no implications*", and drew the conclusion that *"if agents are different in unspecifiable ways, then [...] very few, if any, inferences can be made"* (Arrow, 1991, p. 201).

The main claim of the present paper is that this view is overly pessimistic, and that general equilibrium theory can actually generate strong testable predictions, even for large economies. The main idea is in the line of recent contributions by Brown and Matzkin (1996) and Brown and Shannon (2000), and can be summarized as follows. The approach by Sonnenschein, Debreu and Mantel concentrates on the properties of excess (or market) demand as a function of *prices* only. There are, of course, deep theoretical reasons for the investigation of the structure of aggregate demand as a function of prices; for instance, the Sonnenschein–Debreu–Mantel (SDM) result has strong implications for the convergence of tâtonnement processes. However, this viewpoint is not the only possible one, and actually not the most adequate for assessing the testability of general equilibrium theory. As far as testable predictions are concerned, the structure of aggregate excess demand is not the relevant issue, if only because excess demand is, in principle, not observable, except at equilibrium prices—where, by definition, it vanishes. However, prices are not the only variables that can be observed to vary. Price movements reflect fluctuations of fundamentals, and the relationship between these fundamentals and the resulting equilibrium prices is the natural object for empirical observation. One of the goals of general equilibrium theory is precisely to characterize the properties of this relationship. As it turns out, this characterization generates strong testable restrictions.

We develop our claim in the simple but natural context of an exchange economy, where excess demand depends on both prices *and* initial endowments. The equilibrium equations then relate prices to endowments; the *equilibrium manifold* is defined as the set of prices and endowments for which excess demand is zero. We are interested in the local structure of that manifold; that is, we study equilibrium prices, *locally*, as a smooth function of initial endowments. We derive two main results. First, there exist strong *restrictions* on the local structure of the equilibrium manifold. Some of these restrictions come from the individualism assumption (the aggregate demand arises as the sum of individual demands each of which is a function *solely* of prices and individual income), and others stem from the rationality assumption (each individual is a utility maximizer). In other words, although none of these assumptions constrains the shape of excess demand as a function of prices (the SDM conclusion), they do restrict the form of the equilibrium manifold, which is of empirical relevance.

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