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INEFFICIENT HOUSEHOLD DECISIONS AND EFFICIENT MARKETS

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Abstract

Collective consumption decisions taken by the members of a household may prove inefficient. This paper investigates the impact of inefficient household decisions on market performance when there is competitive exchange among households. Market efficiency can occur when household inefficiencies are merely due to inefficient net trades with the market. On the other hand, if household inefficiencies are solely caused by an inefficient distribution of a household's aggregate consumption to its individual members, then market efficiency is bound to fail.

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1 Introduction

Conventional economic terminology uses "consumer" and "household" as synonyms and with few exceptions, both theoretical and empirical economics have treated households as if they were single consumers. On a practical note, household expenditure data may report the composition of households without disaggregating household consumption (expenditure) and factor supply (income) with respect to household members. Both from a normative and a positive perspective, this prevailing practice raises the question whether it makes any difference who participates in the market, households as entities or household members individually. Such considerations have attracted renewed attention after the widely acclaimed article by Chiappori (1988) who presents a model of collective rationality of households as an alternative to the neoclassical model where households are treated like single consumers. See also Chiappori (1992) and the surveys by Bourguignon and Chiappori (1992) and Kapteyn and Koreman (1992).

Following in the footsteps of Haller (1995), I am going to elaborate further on the normative issue of optimality (efficiency) in a closed model of a pure exchange economy. The issue at hand is whether competitive exchange among households as entities leads to a Pareto-optimal allocation. According to Haller (1995), the answer is in the affirmative as long as each household makes an optimal (efficient) choice subject to its budget constraint and, by doing so, exhausts its budget.

Of course, non-optimal equilibrium allocations can occur even in economies consisting exclusively of one-person households, provided that some consumers possess satiation points in the interior of their budget sets whereas other consumers have non-satiated preferences and exhaust their budgets. With multi-person households rather than individuals participating in the market, this phenomenon is more likely, however. Namely, a household with negative intra-household externalities may have a bliss point despite the fact that each household member has monotonic preferences with respect to her individual consumption. Just imagine a household composed of two smokers. Each household member may individually prefer to always smoke more, since the additional nicotine intake more than compensates for the deterioration of air quality it causes. Nevertheless, the negative externalities due to air pollution can be such that the two smokers agree on an unconstrained "optimum" consumption for the household. Therefore, it is not too surprising that certain externalities lead to sub-optimal equilibrium allocations. Then the major contribution of Haller (1995) consists in identifying externalities that do not hinder Pareto-optimality of equilibrium outcomes: Each household, by internalizing its intra-household externalities, furthers global efficiency. Equilibrium efficiency is obtained, if each household makes an efficient choice under its budget constraint and the nature of consumption externalities among household members is such that an efficient household choice implies budget exhaustion.

Haller's (1995) approach to the optimality issue was biased towards Pareto-optimality in that it identified circumstances under which local efficiency, i.e. household efficiency would lead to global efficiency. But collective household decision making could be prone to severe frictions and, as a consequence, to inefficiencies. Then the question arises how market performance is affected by inefficient household decision making. One intriguing possibility is that inefficiencies at the micro level neutralize each other so that the resulting market allocation is efficient. The more likely scenario is that inefficiencies at the micro level cause global inefficiency, in other words a sub-optimal market allocation. In the present paper, I shall isolate two specific types of inefficient household decisions. In general, one would expect the two types of inefficiency to coexist. It is beyond my current ambition to study the most general case. In fact it turns out that considerable insight can already be gained from investigating each type of inefficiency in isolation. The first type of household inefficiency results from an inefficient net trade with the market and does not rule out global efficiency. The second type of household inefficiency results from an inefficient distribution of the household's aggregate consumption to individual household members and is always causing global inefficiency.

The remainder of this paper is organized as follows. Section 2 introduces a formal model of a pure exchange economy where a household can have several members. Section 3 reviews the special case considered in Haller (1995) where households make efficient decisions under their budget constraints. Section 4 constitutes the innovative part of the paper. It investigates the relationship between inefficient household decisions and market efficiency. Section 5 offers concluding remarks.

2 A Model of Competitive Exchange Among Households

We consider a pure exchange economy composed of finitely many households $h = 1, \ldots, H$. The commodity space is $\mathbb{R}^\ell$ with $\ell \geq 1$. Household h is endowed with a commodity bundle $\omega_h \in \mathbb{R}^\ell$, $\omega_h > 0$.

Each household h consists of finitely many members $i = hm$ with $m = 1, \ldots, M(h), M(h) \geq 1$. Put $I = \{hm : h = 1, \ldots, H; m = 1, \ldots, M(h)\}$. A generic individual $i = hm \in I$ has:

- consumption set $X_i = \mathbb{R}^\ell_+$;
- preferences $\succeq_i$ on the allocation space $\mathcal{X} \equiv \prod_{j \in I} X_j$ represented by a utility function $U_i : \mathcal{X} \longrightarrow \mathbb{R}$.

This general formulation allows for economy-wide externalities. The latter promises to be a fertile topic of research even in the traditional context of competitive exchange among individuals. But in accordance with the main focus of the current paper, I propose to restrict attention to externalities that are of particular interest for an inquiry into competitive exchange among households. In the sequel, condition (E1) will be imposed which requires that consumption externalities, if any, exist only between members of the same household. Some more notation is needed for an explicit formulation of such intra-household externalities.

Let $\mathbf{x} = (x_i)$, $\mathbf{y} = (y_i)$, $\mathbf{z} = (y_i)$ denote generic elements of $\mathcal{X}$. For $h = 1, \ldots, H$, define $\mathcal{X}_h = \prod_{n=1}^{M(h)} X_{hn}$ with generic elements $\mathbf{x_h} = (x_{h1}, \ldots, x_{hM(h)})$. If $\mathbf{x} \in \mathcal{X}$ is an allocation, then for $h = 1, \ldots, H$, household consumption is $\mathbf{x_h} = (x_{h1}, \ldots, x_{hM(h)}) \in \mathcal{X}_h$. Now we are ready to define the kind of intra-household externalities which will be assumed hereafter.

(E1) Intra-Household Externalities: $U_i(\mathbf{x}) = U_i(\mathbf{x_h})$
for $i = hm$, $\mathbf{x} \in \mathcal{X}$.

We shall also refer to the special case of no externalities, i.e.

(E2) Absence of Externalities: $U_i(\mathbf{x}) = U_i(x_i)$
for $i = hm$, $\mathbf{x} = (x_i) \in \mathcal{X}$.

The first welfare theorem asserts that any competitive equilibrium allocation in the sense of Walras is Pareto-optimal. Here, like in Haller (1995), we want to allow for the possibility of a household composed of several members who arrive at a collective decision on household consumption. For the economy with social endowment $\omega = \sum_h \omega_h$ and consumers $i = hm$ $(h = 1, \ldots, H; m = 1, \ldots, M(h))$, a **Pareto-optimal allocation (PO)** is defined in the standard fashion based on individual preferences:

DEFINITION 1
$\mathbf{x} = (x_i) \in \mathcal{X}$ is a **Pareto-optimal allocation**, *if*

(i) $\sum_i x_i = \omega$;

(ii) *there is* *no* $\mathbf{y} = (y_i) \in \mathcal{X}$ *with*

$\sum_i y_i = \omega$;
$U_i(y) \geq U_i(x)$ *for all* i;
$U_i(y) > U_i(x)$ *for some* i.

To complete the modelling of competitive exchange among households, one has to specify how households interact with the market. Haller (1995) assumes efficient bargaining within households. The latter means that a household h chooses an allocation at the Pareto frontier of its budget set, i.e. an element of its efficient budget set $EB_h(p)$ as defined below. In contrast, the present paper is aimed at investigating the impact of inefficient household decisions on market performance. This extended research agenda necessitates a more general definition of a competitive equilibrium among households than the one adopted in Haller (1995). To this end, consider a household h and a price system $p \in \mathbb{R}^\ell$. For

$$\mathbf{x_h} = (x_{h1}, \ldots, x_{hM(h)}) \in \mathcal{X}_h,$$

denote

$$p * \mathbf{x_h} = p \cdot \left(\sum_{m=1}^{M(h)} x_{hm} \right).$$

Then h's **budget set** is defined as

$$B_h(p) = \{\mathbf{x_h} \in \mathcal{X}_h \ : \ p * \mathbf{x_h} \leq p \cdot \omega_h\}.$$

For future reference, we also define household h's **binding budget set** or **balanced budget set** as

$$BB_h(p) = \{\mathbf{x_h} \in \mathcal{X}_h \ : \ p * \mathbf{x_h} = p \cdot \omega_h\}.$$

Demand correspondences describe the possible outcomes of collective household decision making. A (possibly empty-valued) correspondence

$$D_h : \mathbb{R}^\ell \Longrightarrow \mathcal{X}_h$$

is called a **demand correspondence for household** h, if $D_h(p) \subseteq B_h(p)$ for all $p \in \mathbb{R}^\ell$. How households form their demands is a key component of the definition of a competitive equilibrium among households.

DEFINITION 2 *Given a profile $D = (D_1, \ldots, D_H)$ of demand correspondences for households, a* **Competitive D-Equilibrium** *(among households) is a price system p together with an allocation $\mathbf{x} = (x_i)$ satisfying*

(i) $\sum_i x_i = \omega$ *and*

(iii) $\mathbf{x_h} \in D_h(p)$ *for* $h = 1, \ldots, H$.

Thus in a competitive equilibrium, each household makes a collective choice under its budget constraint and markets clear. At this general level, the concept of a competitive equilibrium among households is flexible enough to accommodate all conceivable collective decision criteria of households. Of course, additional restrictions on the profile D could and should be imposed whenever warranted by the objective of the research effort. Occasionally, it may be opportune to replace the market clearing condition (i) by a free disposal condition: $\sum_i x_i \leq \omega$. However, such an occasion will not arise during the course of this investigation.

3 Efficient Household Decisions

Efficient choice by the household refers to the individual consumption and welfare of its members, not merely to the aggregate consumption bundle of the household. Such a notion of efficient household decision is captured by the concept of an efficient budget set.

Given a price system p, we define the **efficient budget set** $EB_h(p)$ by:

$\mathbf{x_h} = (x_{h1}, \ldots, x_{hM(h)}) \in EB_h(p)$ IF AND ONLY IF

1. $\mathbf{x_h} \in B_h(p)$ and
2. there is no $\mathbf{y_h} \in B_h(p)$ such that

   $U_{hm}(\mathbf{y_h}) \geq U_{hm}(\mathbf{x_h})$ for all $m = 1, \ldots, M(h)$;

   $U_{hm}(\mathbf{y_h}) > U_{hm}(\mathbf{x_h})$ for some $m = 1, \ldots, M(h)$.

Classical versions of the first welfare theorem are based on the crucial property that each consumer's demand lies on the consumer's budget set — which implies Walras' Law. This property follows from local non-satiation of consumer preferences. A sufficent condition for the latter is monotonicity of consumer preferences. With the possibility of multi-person households and intra-household externalities, the crucial property needs to be adapted. The modified property stipulates that each household's choice lies on the household's "budget line". It will be called budget exhaustion (BE). Condition (BE) makes the underlying argument appear extremely transparent, if not trivial. It should be emphasized, therefore, that (BE) follows from standard assumptions on the primitive data of the model: Monotonicity in own consumption combined with non-negative externalities yields (BE). The formal definition is as follows.

(BE) Budget Exhaustion: For each household $h = 1, \ldots, H$, and any price system $p \in \mathbb{R}^{\ell}$, $EB_h(p) \subseteq BB_h(p)$.

Notice that $EB \equiv (EB_1(\cdot), \ldots, EB_H(\cdot))$ is an example of a profile of demand correspondences for households. Therefore, a key result of Haller (1995) can be rephrased as follows.

Proposition 1 (First Welfare Theorem) *Suppose (E1) and (BE).*
If $(p; \mathbf{x})$ is a competitive EB-equilibrium, then $\mathbf{x}$ is a Pareto-optimal allocation.

In other words, equilibrium efficiency is obtained, if each household makes an efficient decision under its budget constraint and has to exhaust its budget to carry out such a decision.

4 Inefficient Household Decisions

On purely analytic grounds, it is fruitful to treat the household decision as a two-step decision, although the household need not perceive it that way. In the first step, the household chooses an aggregate or total consumption bundle for the household subject to its budget constraint. In more technical terms, the household determines its net trade with the market. In a more graphic description, the household fixes the dimensions of an Edgeworth Box for the household. In the second step, the household distributes its total consumption bundle among its members. More graphically, the household picks a point (an allocation) within its previously chosen Edgeworth Box. To arrive at an efficient consumption decision under its budget constraint, the household has to first choose the right Edgeworth Box and then pick a point on the contract curve in that Edgeworth Box. Therefore, one can identify two sources of inefficiencies committed by the household:

a) inefficient net trade with the market;
b) inefficient internal distribution.

Of course, the two types of inefficient decision making can be compounded. But it is analytically convenient to consider each of them separately. More importantly, this sort of piecemeal analysis renders interesting results already.

To formalize the two types of household inefficiency, it is convenient to introduce yet another distinguished subset of a household's budget set. For each household h and every price system p, we define the **potentially efficient budget set** $PEB_h(p)$ by:

$\mathbf{x_h} = (x_{h1}, \ldots, x_{hM(h)}) \in PEB_h(p)$ IF AND ONLY IF

1. $\mathbf{x_h} \in B_h(p)$ and
2. there exists $\mathbf{y_h} = (y_{h1}, \ldots, y_{hM(h)}) \in EB_h(p)$ such that
   $\sum_{m=1}^{M(h)} y_{hm} = \sum_{m=1}^{M(h)} x_{hm}$;
   $U_{hm}(\mathbf{y_h}) \geq U_{hm}(\mathbf{x_h})$ for all $m = 1, \ldots, M(h)$.

4.1 Inefficient Net Trades

Suppose that a household performs an inefficient net trade with the market which means that the household could improve (in a weak sense) the welfare of its members by making a different choice under its budget constraint, but in order to achieve that would have to change its net trade with the market. If the household wants to correct its mistake after market clearing, then the net trades of some other households would have to be altered as well, possibly to the detriment of the welfare of the other households' members. This line of argument suggests that inefficient net trades might lead to an efficient market allocation. The following formal result obtains:

Proposition 2 (Accidental Welfare Theorem)
Let $\ell \geq 2$ and consider a non-empty population I partitioned into households $h = 1, \ldots, H$. Then there exist

1. *consumer preferences satisfying (E1) and household endowments,*
2. *a profile of demand correspondences D for the associated exchange economy and*
3. *a competitive D-equilibrium $(p^*; \mathbf{x}^*)$ for that economy*

with the property that

4. *each household h performs an inefficient net trade with the market in the sense that $\mathbf{x_h^*} \notin PEB_h(p^*)$, and*
5. *the allocation $\mathbf{x}^*$ is Pareto-optimal.*

SKETCH OF PROOF. It suffices to outline the argument for the simplest case of two commodities, $\ell = 2$, and a single household, $H = 1$, with a single member denoted i. Consequently, (E1) amounts to (E2). Let the consumer be endowed with the commodity bundle $\omega_i = (1, 1)$ and his preferences be represented by the Cobb-Douglas utility function

$$U_i(x_i) = x_{i1}^{1/2} x_{i2}^{1/2}$$

for $x_i = (x_{i1}, x_{i2}) \in \mathbf{R}_+^\ell$. For each price system $p = (p_1, p_2) \in \mathbf{R}_{++}^\ell$, this consumer has a Marshallian demand

$$x_i(p) = \left(\frac{p_1 + p_2}{2p_1}, \frac{p_1 + p_2}{2p_2} \right).$$

Conversely, at each consumption bundle $\mathbf{x} \in \mathbf{R}_{++}^\ell$, this consumer's inverse demand or supporting price system is given, up to normalization, by grad$U_i(\mathbf{x})$, the gradient of U_i at $\mathbf{x}$.

Let us assume that instead of realizing his Marshallian net trade $x_i(p) - \omega_i$ with the market, the consumer always chooses zero net trade with the market which corresponds to the constant demand function $D(p) \equiv \omega_i$. Now consider the price system $p^* = (1, 2)$. Then $(p^*; \omega_i)$ is a competitive D-equilibrium and ω_i is a Pareto-optimal allocation for this economy. But under his budget constraint, the consumer performs an inefficient net trade with the market, because his actual demand $\omega_i = (1, 1)$ differs from his Marshallian demand $x_i(p^*) = (3/2, 3/4)$. However, the former is Pareto-optimal whereas the latter is socially infeasible. This proves the assertion. □□

Obviously, this trivial example generalizes to arbitrary numbers of consumers ($|I| \geq 1$) and goods ($\ell \geq 2$), to arbitrary household structures and a wide variety of consumer characteristics including instances of competitive equilibria with active trade. Why then the attribute "accidental"? The reason is that the phenomenon of inefficient household decisions consistent with market efficiency is frequent in some sense and rare in some other sense. In support of this assertion, let us revisit the case $\ell = 2$. Let there be $H \geq 2$ single-person households, with both households and consumers labelled $i = 1, 2, \ldots, H$. Furthermore, let each consumer i be endowed with a strictly positive commodity bundle $\omega_i = (\omega_{i1}, \omega_{i2}) \in \mathbf{R}_{++}^\ell$ and have preferences of the Cobb-Douglas type,

$$U_i(x_i) = x_{i1}^{\alpha_i} x_{i2}^{1-\alpha_i} \text{ for } x_i = (x_{i1}, x_{i2}) \in X_i,$$

with $0 < \alpha_i < 1$.

Now fix $\omega_i, i \in I$, and some $\lambda > 0$. Then there exist unique exponents $\alpha_i, i \in I$, and coefficients $\mu_1 > 0, \ldots, \mu_H > 0$ such that

$$\mu_1 \cdot \text{grad } U_1(\omega_1) = \ldots = \mu_H \cdot \text{grad } U_H(\omega_H) = (\lambda, 1). \tag{1}$$

Namely, $\alpha_i = \frac{\omega_{i1}}{\omega_{i2}} \cdot \lambda \Big/ \left(1 + \frac{\omega_{i1}}{\omega_{i2}} \cdot \lambda\right), i \in I$, is necessary and sufficient for (1). Equation (1) in turn is necessary and sufficient for Pareto-optimality of the initial allocation of resources. Hence, whenever (1) holds, the essence of the above one-consumer example is preserved:

Choose again $D_i(p) \equiv \omega_i$ for each i and set $p^* = (\lambda, 2)$. Then $(p^*; (\omega_1, \ldots, \omega_H))$ is a competitive D-equilibrium with inefficient net trades, but an efficient market outcome. This shows that in a specific sense, the phenomenon of inefficient household decisions consistent with market efficiency is a frequent one: Given the endowments ω_i, $i \in I$, variation of λ yields a continuum of corresponding examples. On the other hand, validity of (1) or, equivalently, Pareto-optimality of the initial allocation is not robust with respect to small perturbations of the preference parameters $\alpha_1, \ldots, \alpha_H$. In fact, the no trade allocation given by the endowments ω_i, $i \in I$, is not Pareto-optimal for most choices of preference parameters. But if the initial allocation of resources is not Pareto-optimal, then the foregoing construction of inefficient net trades leading to an efficient market outcome easily collapses. This suggests that in a certain sense, the phenomenon of inefficient household decisions compatible with market efficiency is a rare one.

4.2 Inefficient Internal Distribution

Suppose that a household performs an efficient net trade with the market which means that the household can achieve an efficient choice under its budget constraint by suitably dividing its aggregate consumption bundle among its members. But the actually chosen internal distribution of commodities may be inefficient in the sense that redistribution within the household can improve the welfare of its members. If so, the mistake can be rectified simply by internal reallocation without affecting the welfare of members of other households. This leads to the conclusion that inefficient internal distribution, a particular type of inefficient household decision, always begets global inefficiency. Indeed, the following formal result holds true where $PEB \equiv (PEB_1(\cdot), \ldots, PEB_H(\cdot))$ denotes the profile of potentially efficient budget correspondences.

Proposition 3 (Anti-Welfare Theorem) *Suppose (E1).*
If $(p; \mathbf{x})$ is a competitive PEB-equilibrium and $\mathbf{x_h} \notin EB_h(p)$ for some household h, then $\mathbf{x}$ is not a Pareto-optimal allocation.

PROOF. Assume (E1). Let $(p; \mathbf{x})$ be as asserted and h be a household with $\mathbf{x_h} \notin EB_h(p)$. Since $\mathbf{x_h} \in PEB_h(p)$, there exists $\mathbf{z_h} \in EB_h(p)$ with

$\sum_{m=1}^{M(h)} z_{hm} = \sum_{m=1}^{M(h)} x_{hm}$ and

$U_{hm}(\mathbf{z_h}) \geq U_{hm}(\mathbf{x_h})$ for all $m = 1, \ldots, M(h)$.

Since $\mathbf{z_h} \in EB_h(p)$, but $\mathbf{x_h} \notin EB_h(p)$, $U_{hm}(\mathbf{z_h}) > U_{hm}(\mathbf{x_h})$ for some $m = 1, \ldots, M(h)$. Now set $\mathbf{y_h} = \mathbf{z_h}$ and $\mathbf{y_k} = \mathbf{x_k}$ for households $k \neq h$. This defines a feasible allocation $\mathbf{y} = (y_i)_{i \in I}$. Because of (E1),

$U_i(\mathbf{y}) > U_i(\mathbf{x})$ for certain members i of household h and

$U_j(\mathbf{y}) = U_j(\mathbf{x})$ for all other consumers j.

Hence as asserted, $\mathbf{x}$ is not Pareto-optimal. □□

5 Concluding Remarks

The purpose of this paper is to elaborate on the normative question when competitive exchange among households leads to a Pareto-optimal allocation and, more specifically, to investigate the impact of inefficient household decisions on market performance. Elementary analysis reveals that a particular type of household inefficiency does not rule out market efficiency. The analysis also identifies certain inefficient household decisions that always cause an inefficient market allocation. In either case, the household simply makes a mistake — possibly due to difficulties related to collective decision making.

Frictions in collective decision making could manifest themselves in a different form, not analyzed in the present paper: through resources used up in the decision making process. But then Pareto-optimality in the usual sense might no longer be the appropriate efficiency standard, since very likely resource costs would accrue as well when an outsider tried to interfere in the household's economic affairs.[2]

Regarding the original, broader question whether it makes any difference who participates in the market, Haller (1995) addresses the additional, positive issue of individual decentralization: Does competitive exchange among households lead to outcomes that can also be attained via competitive exchange among individuals? In other words: Given a competitive equilibrium allocation with only households participating in the market, can this allocation also be attained as a competitive equilibrium allocation where the individual household members participate in the market — after being allotted suitable income or endowment shares? The answer is in the affirmative in the absence of any externalities and with standard monotonicity and smoothness conditions. When intra-household externalities are present, individual decentralization of equilibrium outcomes among households is still possible in exceptional cases. But as a rule, individual market participants do not fully internalize intra-household externalities whereas a household does it by assumption.

The basic premise of this paper and of Haller (1995) is that the allocation of resources among consumers and the ensuing welfare properties are obviously affected by the specifics of a pre-existing partition of the population into households. Conversely, the formation and dissolution of households can be driven in part by economic expectations. Becker (1978, 1993) has explored and popularized this idea. Preliminary work by Gersbach and Haller (1995) aims at studying the simultaneous allocation of consumers and commodities in a general equilibrium context.

[2]Coase (1988), p. 26, makes a similar observation with respect to production: "... the mere existence of 'externalities' does not, of itself, provide any reason for governmental interventions. ...... The fact that governmental intervention also has its costs makes it very likely that most 'externalities' should be allowed to be continued, if the value of production is to be maximized."

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