Property and the Dynamics of Market Price Discovery in Classical Economics

International Symposium on Economic Thought
April 14, 2022

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Price discovery, first market experiment, 1955. We had no theory of how/why. Adam Smith did. But first he had to find the origins of property.

CHART I
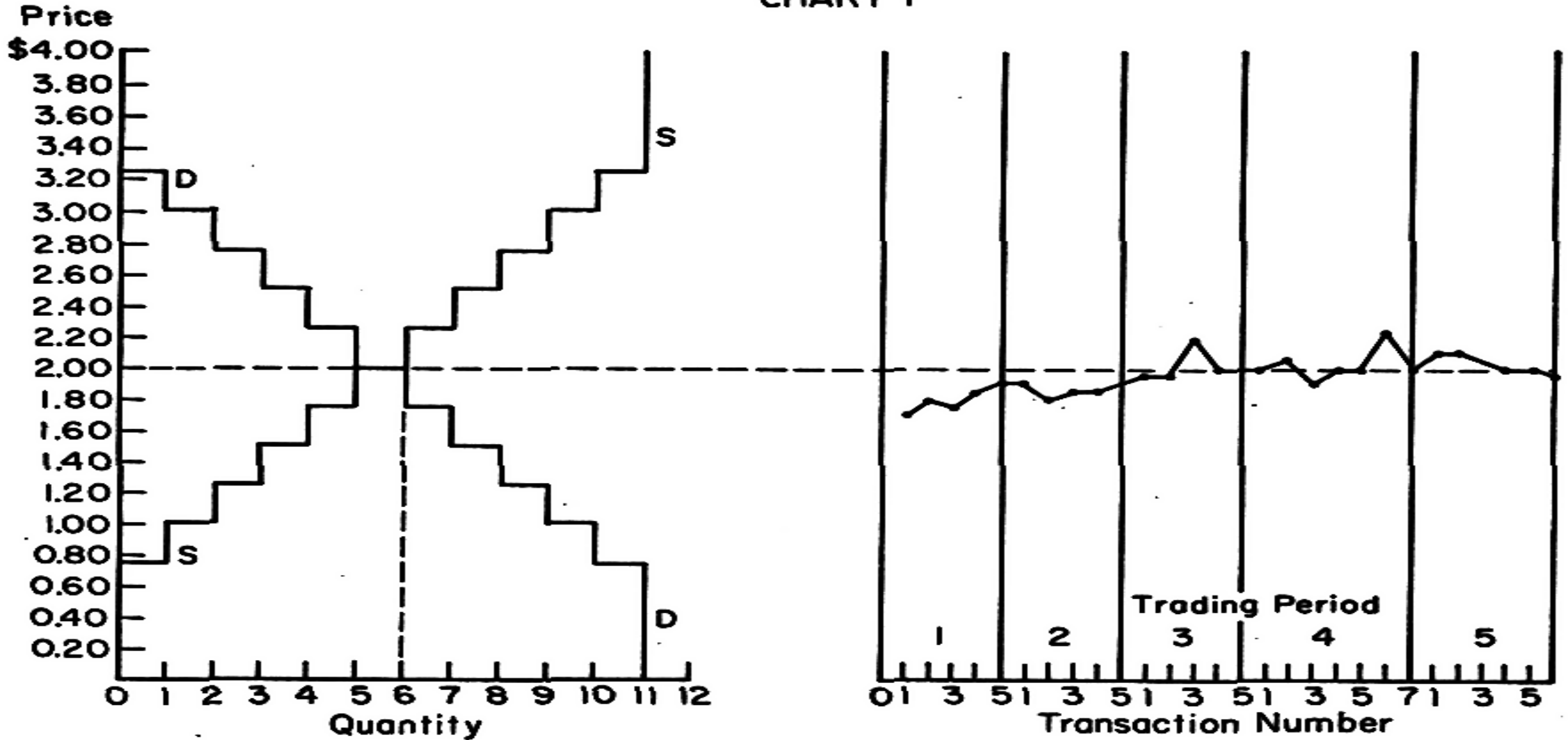
Hence, our theme: Adam Smith made original contributions to

(1) the origins of property, essential to socio-economic order; and

(2) market price discovery theory.

His thinking/modelling style has a fresh relevance for social and economic theory today. Smith's model is consistent with market experiments.

(1) In *TMS* (1759) Smith's model of other-regarding social action explains & predicts how and why we get along, or not, with our neighbors.

Propositions on Beneficence and Justice constitute the foundation of human sociability and exchange.

*Beneficence underlies reciprocity in social exchange and trade in markets.
*Justice underlies property; necessary if market exchange is to give cause for the wealth of nations.

(2) In *WN* (1776) Smith models price formation from the perspective and experience of the buyers and sellers in the market. His model of supply and demand differs from that of neoclassical theory but conformed to that of modern game-theoretic models of auctions and predicts the patterns observed in market experiments 180 years later.

Smith's methodology in both WN & TMS is to model the roots/origins of action in feelings, experience, and learning to know how to act. Then he inquires as to the consequences of actions for society and economy. He did not propose to choose A over B, iff U(A) > U(B), thus welding origins to consequences.

SOCIAL THEORY: Two Pillars of Society are Beneficence & Justice. Beneficence explains & predicts positive reciprocity in society & trade in economy; Justice explains & predicts using punishment to deter actions intended to hurt. TMS: Justice→Security-from-Injury→Property. WN: Justice, as rule-of-law, aims to secure each individual from injury *by government, by neighbors, and by foreigners.*

Beneficence Proposition 1 (BP1): "Actions of a beneficent tendency, which proceed from proper motives [intentional], seem alone to *require* reward; because such alone are the approved objects of gratitude, ..." (*TMS,* 1759, p 112)

Justice Proposition 1 (JP1): "Actions of a hurtful tendency, which proceed from improper motives, seem alone to *deserve* punishment; because such alone are the approved objects of resentment..." (TMS, p 112)

Of These Two Pillars, Justice Is The More Essential:

" Society...cannot subsist among those who are at all times ready to hurt and injure one another... Beneficence, therefore, is less essential to the existence of society than justice."(TMS, p 124-5)

Both pillars require common knowledge that all are self-interested: Otherwise, none can know what constitutes a "benefit" or a "hurt" in others.

Notice: Smith distinguishes *being* self-interested from *acting* self-interestedly; self-interested people learn, interacting with others, to act in other-regarding ways.

IN TMS, JUSTICE PROPOSITION 1 IS THE ORIGIN OF PROPERTY

Resentment of intentionally hurtful actions in close-knit communities is the origin of the civil order of law, and of punishment proportioned to resentment.

"The violation of justice is injury…real and positive hurt to…persons, from motives…naturally disapproved of. It is, therefore, the proper object of resentment, and of punishment…As the greater and more irreparable the evil that is done, the resentment of the sufferer runs naturally the higher…" (TMS, pp 114, 121)

In TMS, Smith first models the roots/origins of action: in feelings, experience, & action-know-how. Then he examines the consequences of action. Property evolves from our resentment/punishment of hurtful acts.

In WN, wealth is created by specialization, which is determined by the extent of markets whose function is to find prices. Hence, Smith models price formation as emerging from the decentralized interaction of the collective of buyers and sellers in a market.

IN DEMAND THEORY, WHEN CONSUMERS ARRIVE IN MARKETS, HOW DO WE, IN THEORY, EXPRESS THEIR DEMAND? HOW DID SMITH? THREE PERSPECTIVES:

General Equilibrium (GE) theory. Pre-market problem: Given prices, we Max U s.t. income constraint, and derive optimal Q = D(p). But prices have not yet been discovered in markets!!

Marshall theory: He followed the GE math model, but when he verbalized price formation in a country corn market, he applied WN (Bk I, Ch VII); buyers come to market with Max WTP values, v = f(Q). Marshall then substitutes P for v! But values merely bound potential prices.

Auction (Vickery, 1961) theory: Q buyers bring to market a Distribution Function of Max WTP values, v = f(Q).

Classical Economists Represent Market Agents As In Auction Theory:

Commodity space is discrete; transactions involve single units or batches of goods. Think of *your* shopping basket with 1 qt. milk, # bacon, jar olives, box of cereal. Markets convenience-package items, solves consumer inventory problem

Buyer value for each unit is measured by the maximum amount of money each is willing to pay, or give up, v = Max wtp, but they are motivated to buy cheap. We can write this in the explicit form, $Q = D (p; v \geq p)$

Sellers each have minimum amount of money they must receive in order to give up a unit of product, c = Min wta, but they are motivated to sell dear. We can write this explicitly as $Q = S(p; c \leq p)$

Thus buyers (sellers) are represented by simple buy-cheap (sell-dear) "higgling and bargaining" strategies with demand (supply) defined as limits on their wtp (wta). (A. Smith, 1776, Bk 1, Ch VII).
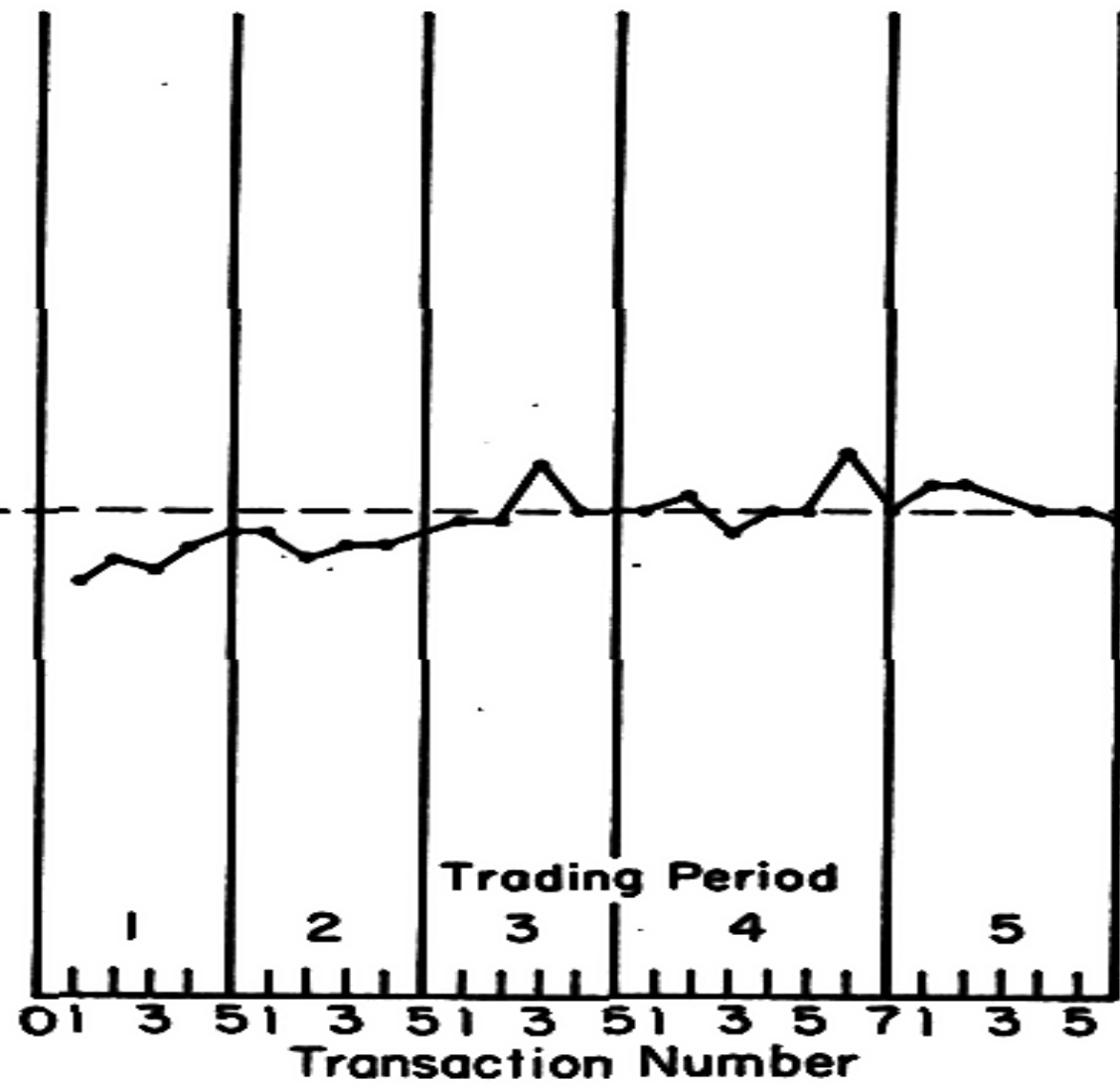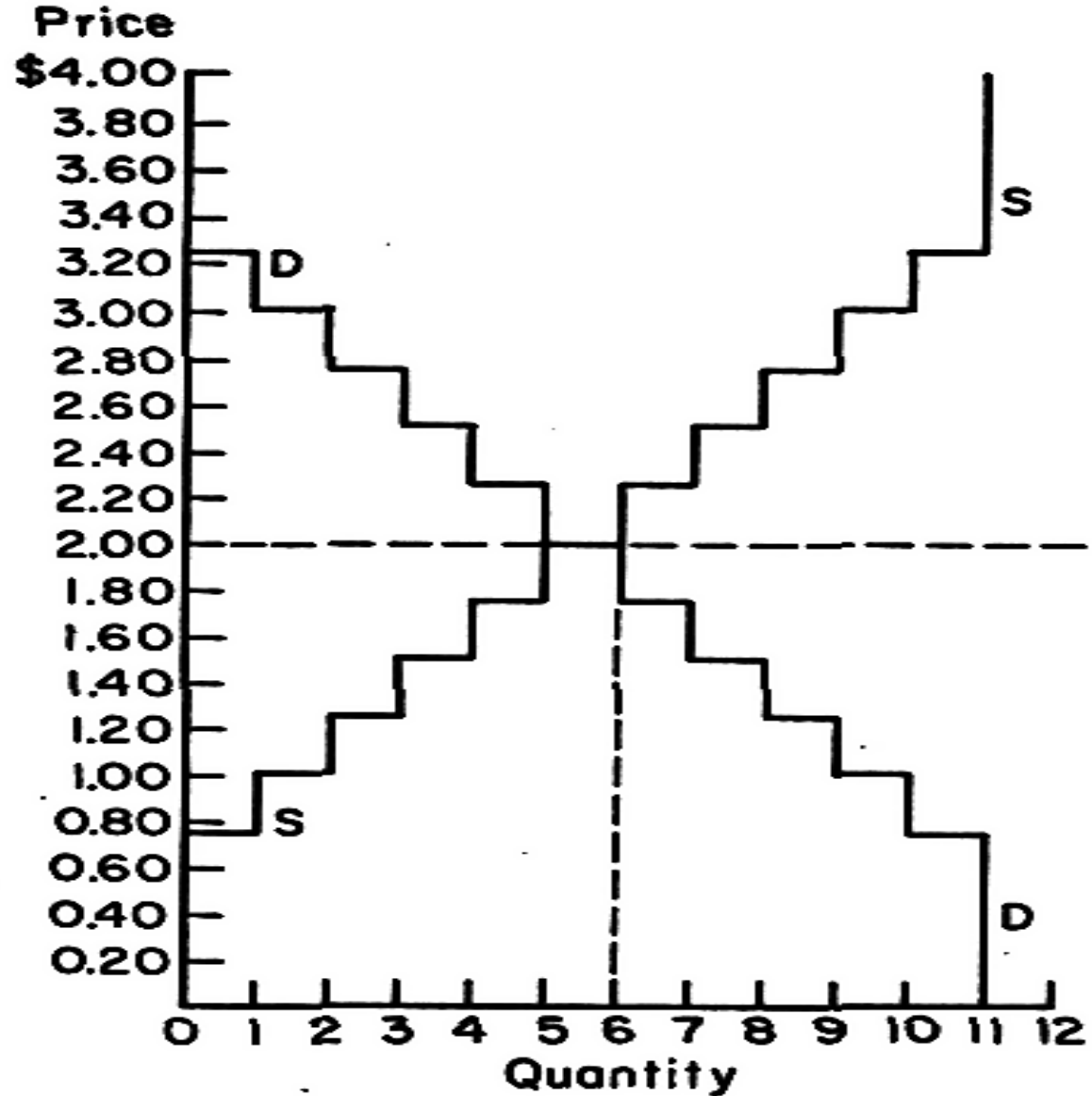
Smith knew about auctions: "if two buyers equally desire an item, the one with the larger wealth will carry it" He knew that the high bid wins, that taste, and wealth matter—thus guiding his thoughts on demand (supply).

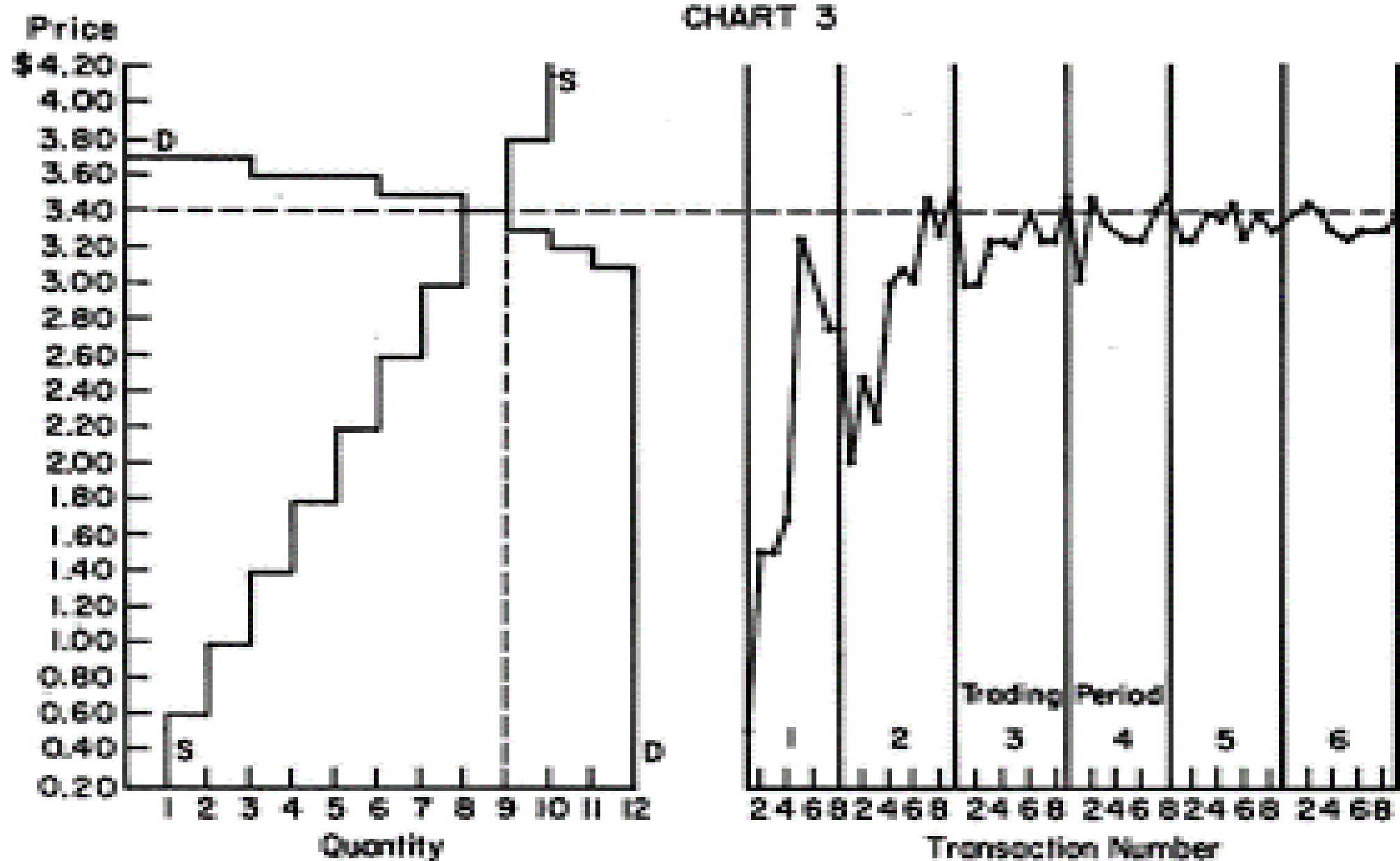# 1st experiment Jan. 1956; "Price" on Y-axis is error!

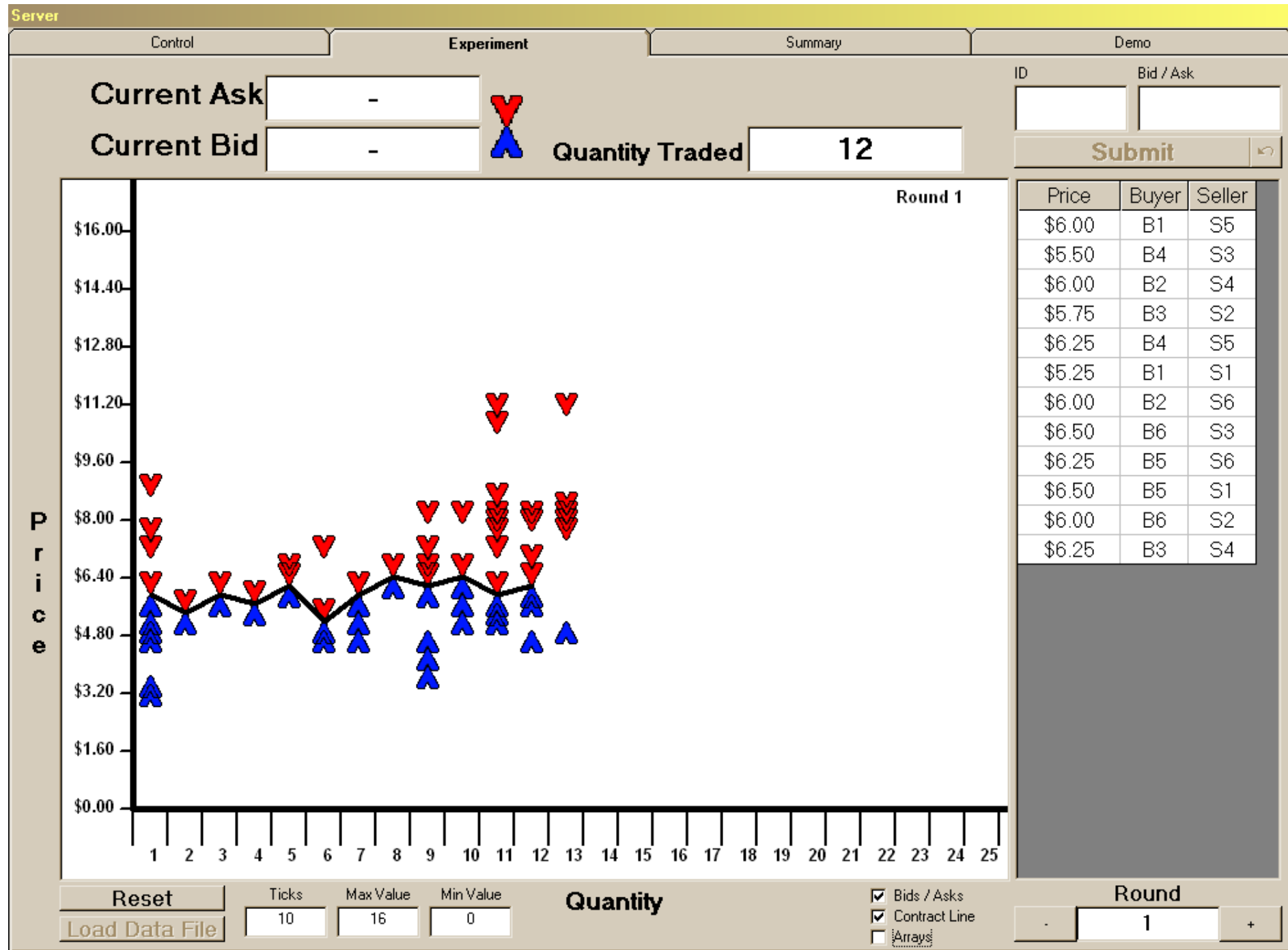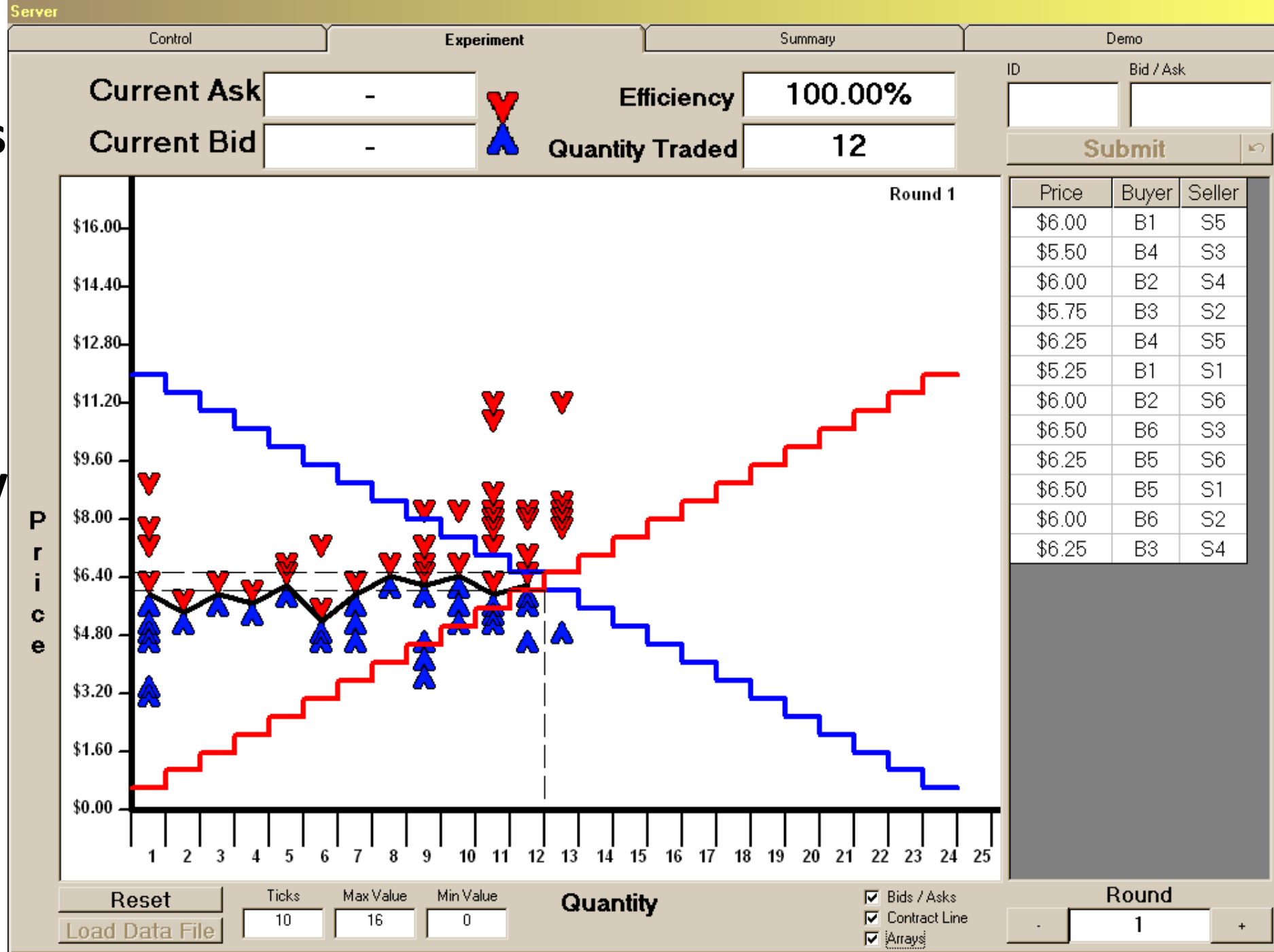D= -DF, WTP values; S = DF, WTA costs   Found Prices

CHART I

Convergence is not an artifact of S & D symmetry!

Recent Experiment: Prices found in real time; with wtp & wta private

Each of 6 buyers & 6 sellers have 4 Unit Capacity & Trade 2 Near Center; 100 % efficient

Market process dynamics, in Adam Smith:

If quantity brought to market "falls short of effectual demand...those willing to pay" the supply price "cannot be supplied" (Purchases are limited by supply); some will bid for what they can get, and price will increase. Smith (1776, p 58)

If quantity brought to market exceeds demand, cannot all be sold to buyers willing to pay the supply price (Sales limited by demand) and price falls. Smith (1776. p 59)

Two-part theory in *WN*: (1) price change has same sign as excess demand; (2) at any price the contracted quantity is limited by minimum of amount demanded or supplied.

ELEMENTARY MATHEMATICAL VERSION OF WN, BK I, CH VII.

1. **Motivation: Buyers (sellers) have (v_i)= Max wtp; ((c_k)= Min wta) values (costs); seek to buy cheap (sell dear).**

   As in experiments, (v_i, ck) *is* replicated in period T = 1, 2, 3 ...

2. **Price adjustment rule: Price change and excess demand, e(p), have the same sign:**

   e(P) dP/dt > 0 if e≠ 0. Transaction t = t' + T (trade t' in period T)

3. **Let V(P) = integral of -e(P); dV/dt = −e(P) dP/dt ≤ 0 ; i.e., V (t) is non-increasing.**

For discrète values and costs

$$V(p) = \sum_i (v_i - p)d_i(p) + \sum_k (p - c_k)s_k(p).$$

So, V = overall distance in profit space between price and the traders' reservation valuations/costs that are profitable at p.

P* = Center of Market Value

$\quad$ = arg min *V(P)*

$\quad$ = arg max *TS(P)*

$\quad$ = arg max (min [s(P), d(P)]).

Principle of maximum information: **Market Price Evolves so as to Reflect Value Better and Better: $\Delta V(t) \leq 0$. The distance between price and value decreases through competition.**

Implicitly, we have the classical foundations of Hayek, Hurwicz-Reiter-Radner on informational efficiency.

We use Shannon (1948) below to calculate the explicit information content in prices.

THEOREM : Assume a competitive market (in the classical sense, not price taking!). Assume no re-trading takes place (hence no speculation). Then price converges to minimum price-value distance, maximum trade, and maximum surplus.

Illustration: a large market with values and costs drawn from an exponential distribution

(value, cost)
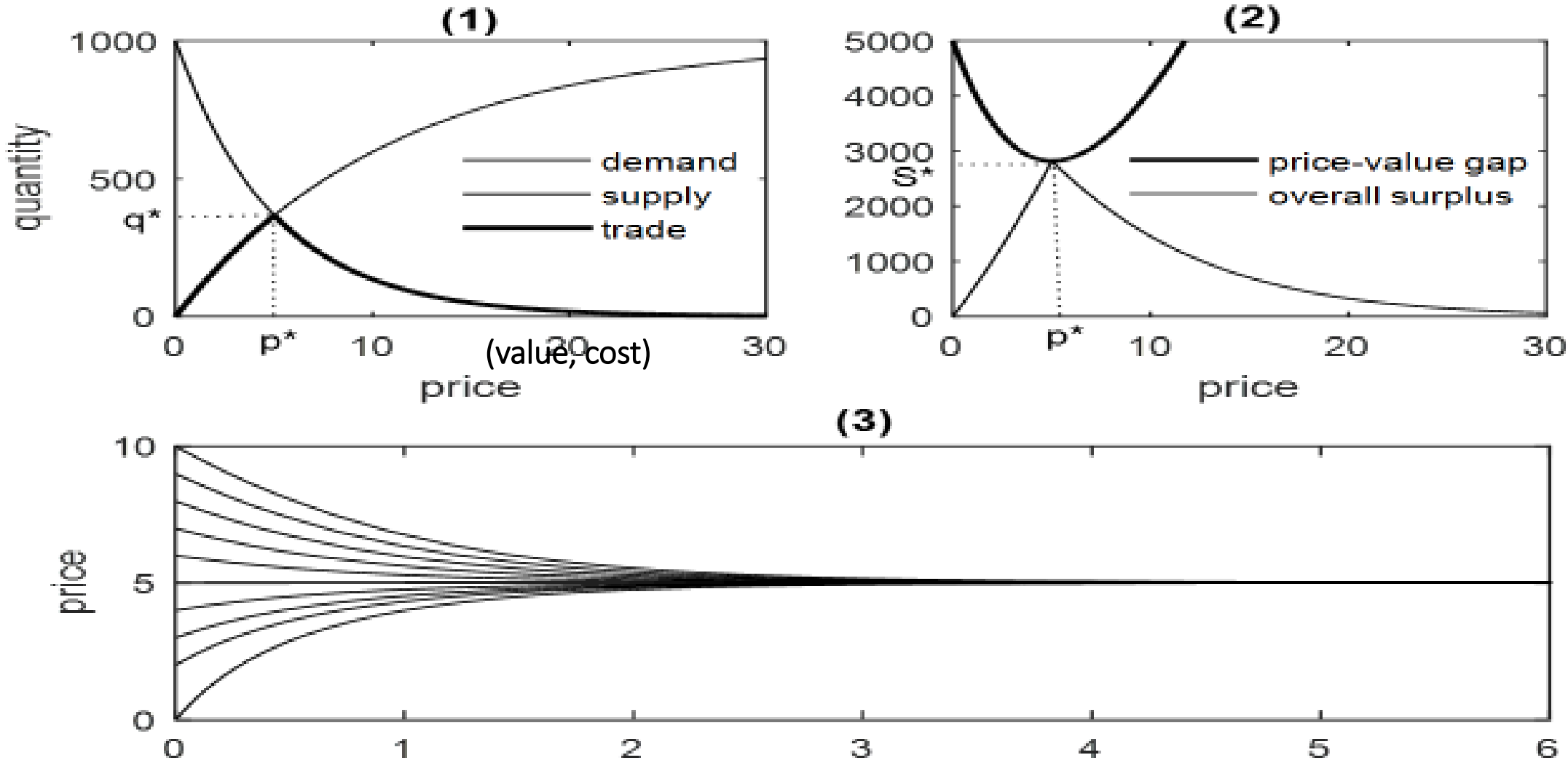
Information Theory: A transaction concluded at price p reveals publicly the existence of a cost $c \leq p$ and a value $v \geq p$ that were private information. The trade is the conjunction of these two events. v measures resource value added to society; c measures resource value foregone or used-up by society. Hence, the trade *informatively signals a net economic gain for society*. Shannon (1948) proposed measuring the information in an event realization by log probability of the event. Thus, the change in information, I (p), for a smooth large market is

$$\frac{dI}{dp} = \log \frac{D(p)}{S(p)}.$$

Hence: the change in transaction information with a changed p is non-negative:

$$\frac{dI}{dt} = \left\{ \log \frac{D(p)}{S(p)} \right\} \frac{dp}{dt} \geq 0.$$

This generalization of the Classical Model of price discovery is parameter free until we specify an institution defined by explicit rules governing how buyers and sellers interact: E.g., we illustrate the model's application below for

Multiple unit English auction, with Q = 4;

Multiple unit (4 units) simulated English auction. (a) Reservation values and costs. (b) Price dynamics (min bid increment = 5). (c) Potential surplus, (V(p), and information I (p). (d) V(t); T = 1
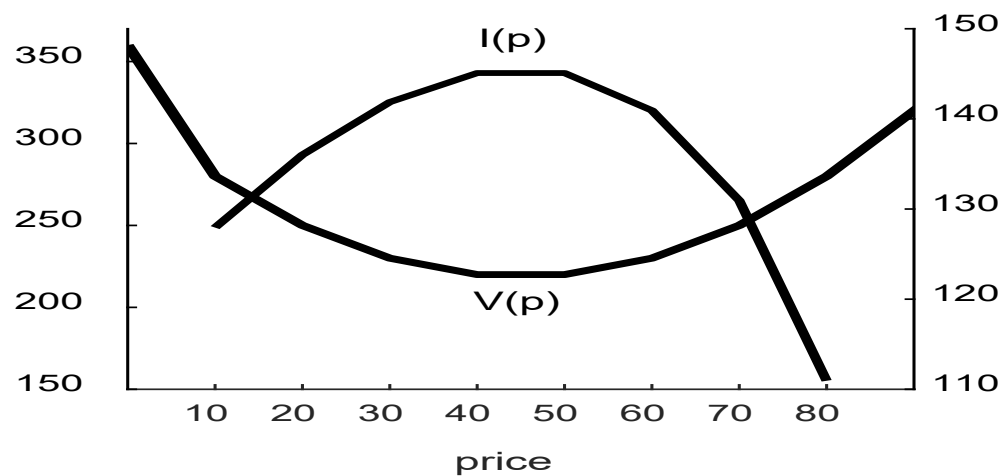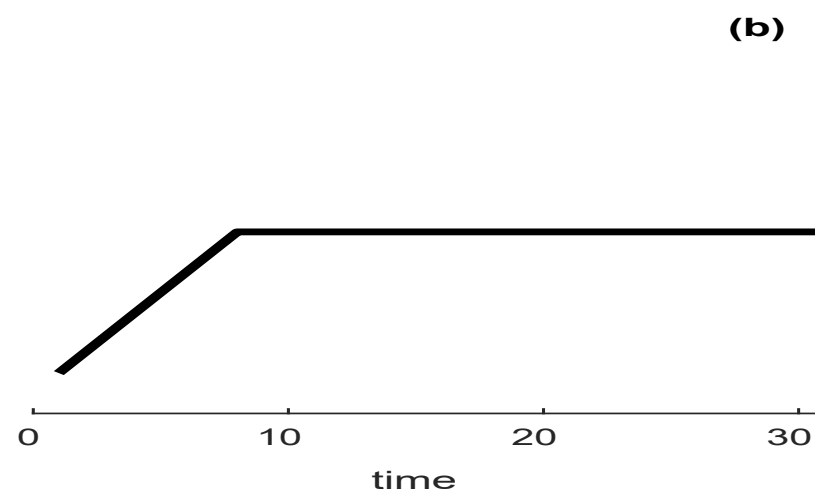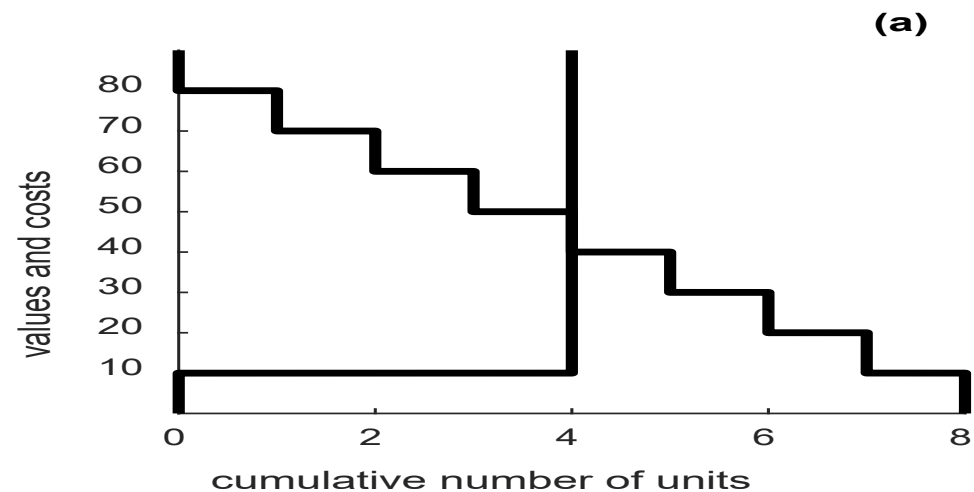
CONCLUSION: MARKETS WITH PRIVATE INFORMATION, IN WHICH PEOPLE TRY ONLY TO DO BEST FOR THEMSELVES, COLLECTIVELY DO BEST FOR ALL: Min V (p*); Max I (p*)

SUMMARY

In TMS (1759) Smith's Proposition on Beneficence underlies social exchange in civil society; economic exchange in markets. His Proposition on Justice underlies property, a necessary condition for markets to create wealth.

In WN (1776) Smith models price formation from the perspective and experience of the buyers and sellers in the market. Smith's theory predicts the patterns observed in the first market experiment 180 years later.

Smith models the decentralized roots/origins of action in people; then inquires as to the consequences of action: Social exchange & property, TMS; economic exchange in markets WN.

THANK YOU
Download free and study:

Smith, A. (1759) *The Theory of Moral Sentiments* **An essay towards an analysis of the principles by which men naturally judge concerning the conduct and character first of their neighbors and afterwards of themselves;** Dugald Stewart Edition (London: Henry G. Bohn, 1853). https://oll.libertyfund.org/title/smith-the-theory-of-moral-sentiments-and-on-the-origins-of-languages-stewart-ed

Smith, A. (1776) *An Inquiry into the Nature and Causes of the Wealth of Nations by Adam Smith,* Edwin Cannan Edition (London: Methuen, 1904). 2 vols. https://oll.libertyfund.org/title/smith-an-inquiry-into-the-nature-and-causes-of-the-wealth-of-nations-cannan-ed-in-2-vols