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Testing the boundaries of the double auction: The effects of complete information and market power☆

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ABSTRACT

We report boundary experiments testing the robustness of price convergence in double auction markets for non-durable goods in which there is extreme earnings inequality at the competitive equilibrium (CE). Following up on a conjecture by Smith (1976a), we test whether the well-known equilibrating power of the double auction institution is robust to the presence of complete information about traders' values and costs and the presence of symmetric market power. We find that complete information is insufficient to impede convergence to CE prices; however, introducing market power consistently causes prices to deviate from the CE, whether or not subjects possess complete information. Our design highlights the value of boundary experiments in understanding how market institutions shape behavior, and our findings help delineate the limits of the double auction institution to generate competitive outcomes.

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A market, then, is theoretically perfect only when all traders have perfect knowledge of the conditions of supply and demand, and the consequent ratio of exchange […] So essential is a knowledge of the real state of supply and demand to the smooth procedure of trade and the real good of the community, that I conceive it would be quite legitimate to compel the publication of any requisite statistics.

W.S. Jevons (1871)

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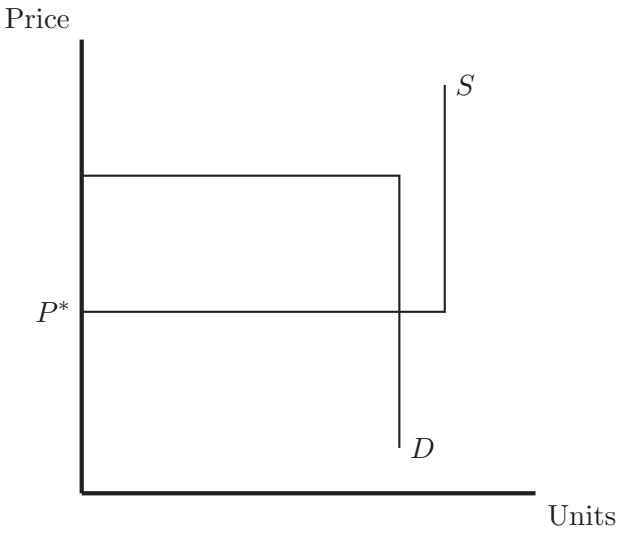

Fig. 1. Market with all surplus obtained by buyers at the CE.

> *If the reader bristles at the acceptance of assumptions such as perfect knowledge [...] He is right if he believes these extreme assumptions are not* necessary *to the existence of competition [...] The reason for not stating the weakest assumptions (necessary conditions) for competition is that they are difficult to formulate, and in fact are not known precisely.*
>
> G.L. Stigler (1966)

> *One of the most prominent, replicable, empirical properties of the double auction competitive price mechanism is its rapid convergence to the supply and demand equilibrium under the condition of incomplete information […] It might be supposed that under complete information, where each agent is informed of the value and cost functions of other agents, market convergence would improve, or at minimum not be worse […] [T]here is at least one class of crucial experiments for which this proposition must be rejected, namely the class in which all the exchange surplus is obtained by the buyers (or sellers) at the equilibrium price.*
>
> V.L. Smith (1980)

1. Introduction

Probably the most widely replicated experiment in economics shows the power of the continuous double auction institution to generate competitive equilibrium (CE) allocations of non-durable goods. Beginning with Smith (1962), experiments have shown that even markets composed of inexperienced traders, possessing incomplete information about supply and demand, rapidly converge to the CE after only a few market repetitions. This striking result has been subjected to a number of powerful stress tests, yet the convergence properties of the double auction remain robust. In particular, convergence is robust to variation in the number of buyers and sellers (e.g. this number need only be greater than two; see Smith, 1981; Smith and Williams, 1990), to within-session changes in the supply and demand arrays, and to both computerized and hand-run implementation; see (Davis and Holt, 1993) for a survey of the classic literature.

In a particularly rigorous stress test, Smith (1965) provides evidence that equilibrium is still achieved in a so-called "swastika" supply and demand array. In such a market (see Fig. 1), all the exchange surplus goes to one side of the market at the CE price.[1] As Smith (1982b) and Holt et al. (1986) note, such a supply and demand environment provides a uniquely stringent test of the equilibrating capabilities of the double auction since there exists a continuum of prices that support efficient, though non-competitive, allocations. Nevertheless, Smith (1965, 1982b), and Holt et al. (1986) all report that such markets converge to the CE. This result has also been replicated in a number of studies, all of which (to the best of our knowledge) are summarized in Table 1, which provides references and catalogues the institutional details of each session.

As noted in Smith (1980, 1982a, 1982b), the fact that such markets converge to CE allocations—despite traders having *incomplete information* about supply and demand conditions—is a challenge for neoclassical theories of competition.[2] Few, perhaps none, of the critical theoretical conditions for the existence of a CE are satisfied in the double auction markets in

[1] Cason and Williams (1990) refer to such a supply and demand environment as an "extreme earnings inequality" design. As we note, this is true of these markets at the CE, but this label is less descriptive of the market configuration than "swastika" design, despite the unfortunate connotations of the latter.

[2] See e.g. the opening quote from Jevons (1871) for the classic statement of the view that complete information is a necessary condition for CE—so necessary that it might justify coercion.

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