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May 2011

Discussion Paper

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# Markets as economizers of information: Field experimental examination of the “Hayek Hypothesis”

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December 2010

## Abstract

The work of Friedrich Von Hayek contains several testable predictions about the nature of market processes. Vernon Smith termed the most important one the ‘Hayek hypothesis’: equilibrium prices and the gains from trade can be achieved in the presence of diffuse, decentralized information, and in the absence of price-taking behavior and centralized market direction. Vernon Smith tested this by surveying data on laboratory experimental markets and found strong support. We repeat this exercise using field experimental market data. Using field experiments allows us to test several other predictions. Generally speaking, we find support for Hayek’s theories.

JEL codes: B53, C90, D40, D51, D61, D82, L26

Keywords: price dynamics; entrepreneurs; field experiment; market process

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<sup>1</sup> We wish to thank Pete Leeson for helpful comments. Al-Ubaydli (corresponding author) and Boettke: Department of Economics and Mercatus Center, George Mason University.

# 1. Introduction

In an effort to test Hayek's (1945) theories of the market process, Vernon Smith (1982) reviewed the (even by then) extensive laboratory evidence, concluding that "... in all three of the double auction environments studied experimentally... the evidence is consistent with the Hayek hypothesis," (1982: p176). Smith went on to inquire: "... does this mean that it will do comparably well in the 'field' environment of the economy?," noting that "few such field experiments have been attempted," (1982: p177). Almost 30 years later, many such field experiments have indeed been attempted; this paper picks up where Smith (1982) left off and assesses how well Hayek's theories travel in the field.

The advantages of laboratory experimental data over naturally occurring data are well-documented (Falk and Heckman 2009). In the context of market experiments, the most important is the control that the laboratory affords the investigator, permitting him to induce demand and supply, and to have full knowledge of the predicted equilibrium. Field experiments complement their laboratory counterparts by, among other things, allowing the investigator to observe more diverse contexts and to limit the difficulties arising from inexperienced experimental subjects (see Harrison and List 2004 and Levitt and List 2007).

Hayek (1945) provides several testable predictions about the market process.<sup>2</sup> The most important, which Smith (1982) denoted the 'Hayek hypothesis', is that equilibrium prices and the gains from trade can be achieved in presence of diffuse, decentralized information<sup>3</sup>, and in the absence of price-taking behavior and centralized market direction. Critically, as Smith (1982) noted, these predictions are sometimes at odds with those of the neoclassical model.<sup>4</sup>

We find that overall, Hayek's theories are well supported by the field experimental data. However we also find that there are important exceptions that open the door to refinements of Hayek's theories. For example in certain environments, the presence of experienced entrepreneurs and the dissemination of price information can hinder the equilibration process in markets.

The remainder of this paper is organized as follows. Section 2 is an overview of experimental methods. Section 3 briefly explores Hayek's testable theories. Section 4 reviews the field experimental evidence on these theories. Section 5 concludes.

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<sup>2</sup> The strictest presentation of Hayek's theories precludes the testing of several of the predictions that we consider in this paper, e.g., arguably, according to Hayek it is impossible to know the competitive equilibrium in any market (experimental or otherwise). However following Smith (1982), we consider hybrid forms of Hayek's theories that take advantage of the extra control afforded by experimental settings. We further discuss this issue below.

<sup>3</sup> Formally, imperfect information and lack of common knowledge.

<sup>4</sup> Perhaps more importantly, they apply in an environment where the neoclassical model typically fails to even articulate predictions due to Knightian uncertainty (Phelps 2006). Further, much of Hayek's research has focused on price dynamics and the role of entrepreneurs in driving the market towards equilibrium. Partially due to the difficulties of tractably modeling price dynamics, neoclassical economics has provided a limited range of testable predictions in this area.

## 2. Experimental methods

To fully comprehend the implications of field experimental data for Hayek's theories, we need to lay out the exact advantages implied by experimental methods in general, as well as the relevant advantages of field experiments. For a full discussion of laboratory experiments, see Davis and Holt (1992) or Kagel and Roth (1997), and for field experiments, see Harrison and List (2004).

### A. Laboratory experiments

As we will explain in the next section, Hayek's market theories are only testable if the investigator has knowledge of:

- The potential gains from trade
- The prices that permit the gains from trade to be realized

In other words, the investigator needs to know the demand and supply schedules, as well as the implied equilibrium price.<sup>5</sup> In the absence of massive (and untestable) structural assumptions, this information is impossible to obtain from naturally occurring data. The laboratory allows the investigator to control preferences and costs and hence precisely induce the demand and supply schedules (Smith 1976, 1982). The investigator can also control (partially or completely):

- The information available to market participants
- The communication permissible between market participants
- The contracts available to market participants
- The horizons of interaction permissible between market participants

### B. Field experiments

There are three types of field experiment which lie within a larger taxonomy (see Harrison and List (2004)).

- **Conventional lab experiment:** a standard subject pool of students, abstract framing and an imposed set of rules
- **Artefactual field experiment:** same as a conventional laboratory experiments but with a non-standard subject pool, e.g., having general members of the population participate in a laboratory market
- **Framed field experiment:** same as an artefactual field experiment but with a field context in either the commodity, task, or information that the subjects can use, e.g., having professional traders participate in a laboratory market that functions similarly to the market in which they normally operate

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<sup>5</sup> In principle, some of the theories are testable without knowing the full schedules; however there is no doubt that a richer array of testing is permitted by knowledge of the demand and supply schedules.

- **Natural field experiment:** same as a framed field experiment but where the environment is the real environment where the subjects undertake these tasks, and where the subjects are not aware that they are in an experiment, e.g., performing an experiment in the New York Stock Exchange without the knowledge of the traders

In the case of markets with induced (and hence known) demand and supply schedules, natural field experiments are impossible. Compared to the remaining field experiments, laboratory experiments potentially suffer from the following drawback (see Harrison and List 2004, Levitt and List 2007, Falk and Heckman 2009): subjects may be inexperienced in the task, and self-selection into the experiment may bias results. For example, the outcomes of a market may depend upon the inept traders having been whittled out, which is much less likely to have occurred in a laboratory experiment. As we will discuss below, this may be particularly important in the context of Hayek's theories.

An additional advantage of field experiments is the ability to consider longer-term issues such as reputation. When using students as subjects in an unnatural environment, reputational horizons rarely extend into months or years, in contrast to using subjects drawn from the natural environment being studied; field experiments extend the domain of analysis.

Even setting aside these potential advantages of field experiments, it is useful to extend the domain of inquiry to as many different markets as possible purely as a standard act of robustness-checking. Most likely, this is what Smith (1982) had in mind when he posed the question about the generalizability of the laboratory support for Hayek's theory to field settings.

### **3. Hayek's testable theories**

Hayek (1940, 1967) argues against a model of behavior where agents' preferences are determined separately from market processes; he believes that the process of competition is central to the manner in which agents assess how much they value commodities. At face value, this poses difficulties for deploying induced value theory (Smith 1976) in an experiment in an attempt to induce competitive equilibria.

To overcome this, Smith (1982) relaxed some of the assumptions of the Hayek framework, noting that much of what Hayek proposed about markets applies in principle even if values and competitive equilibria can be induced. We follow Smith (1982) and thus the hypotheses that we present and test can be considered as (Vernon) Smithian interpretations of Hayek.

Smith (1982) remarks that the standard proposition of decentralized market theory is that the gains from trade will be exhausted; further, prices will converge to the competitive equilibrium implied by the intersection of demand and supply. The divergence between Hayek and neoclassical scholars arises when one considers the conditions necessary for these outcomes, and the precise mechanism by which the competitive equilibrium is attained.

**Hypothesis 1 (*The Hayek hypothesis*; Hayek 1945):** The competitive equilibrium will be attained (and the gains from trade exhausted) even if:

- a) The number of traders is small
- b) Traders can act as price-setters
- c) Traders have extremely limited information about the conditions of the market, including complete ignorance of anything beyond their own preferences
- d) Traders may or may not have rational expectations (or common knowledge) over market conditions
- e) There is no centralized market orchestrator

The standard competitive model adheres to some of these conditions at the expense of others. By having a central auctioneer (or some other *deus ex machina*) setting prices and a large (infinite) number of price-taking agents (violating conditions (a), (b) and (e)), the standard competitive model predicts competitive equilibrium despite agents having very limited information (satisfying conditions (c) and (d)).

The bargaining literature that emerged in the 1980s and early 1990s (e.g., Rubinstein and Wolinsky 1985, Wolinsky 1988, 1990, and Gale 1987) operated under the opposite configuration of conditions. There can be a small number of traders who set prices in a decentralized environment (satisfying conditions (a), (b) and (e)); however, subject to some minor imperfect information, the features of the environment are common knowledge (violating conditions (c) and (d)). Moreover the models in this bargaining literature rarely predicted competitive equilibrium and/or exhaustion of the gains of trade.<sup>6,7</sup>

This was the hypothesis that Smith (1982) tested using laboratory data. Notice that it is impossible to test without knowledge of demand and supply (and hence the competitive equilibrium), hence the reliance on laboratory experimental data. Despite being aware of the following additional hypotheses, Smith (1982) did not test them, likely due to the unsuitability of laboratory (rather than field) experimental methods.

For each of the following hypothesis, conditions (a) to (e) above apply.

**Hypothesis 2 (Hayek 1948, 1967):** Entrepreneurs drive dynamics and equilibration; specifically, they move markets towards the competitive equilibrium and drive the realization of the gains from trade.

Entrepreneurship is the alertness to a previously unrecognized opportunity for mutual gain (Kirzner 1973). Mises (1949) operationalizes this definition by describing entrepreneurs as promoters and

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<sup>6</sup> In some cases, as frictions (such as bargaining costs or positive discount rates) tended to zero, the model would predict efficiency.

<sup>7</sup> The reliance upon rational expectations (specifically no Knightian uncertainty) is not necessarily an intellectually premise of these models; it is more of a modeling standard. In this paper, we purposefully *avoid* the debate over the desirability of rational expectations as a modeling standard (see Frydman 1982); our goal is simply to explore the hypotheses that are derivable from a Smith (1982) interpretation of Hayek's work, which happens to not assume rational expectations, and to see how well they perform empirically.

speculators, eager to profit from discrepancies in the price structure. This should be contrasted with market participants who pursue final consumption (Kirzner 1997).

An essential feature of the market process is that incompetent entrepreneurs are eliminated through evolutionary selection pressure (Kirzner 1997). The student subject pools that comprise the participants in laboratory markets are not recruited from any real market (or at least one that is sufficiently similar to the laboratory market in which they are about to participate). This is why field experiments are necessary for testing Hypothesis 2.

**Hypothesis 3 (Hayek 1948, 1945):** The dissemination of price information pushes markets towards the competitive equilibrium and facilitates the realization of the gains from trade.

**Hypothesis 4 (Hayek 1948):** Reputation is very effective at preventing asymmetric information from impeding the realization of gains from trade.

As mentioned above, field experiments offer investigators a richer array of data for testing this hypothesis, especially since horizons longer than can be achieved in a typical laboratory experiment are sometimes required to overcome problems of asymmetric information.

## 4. Field experimental evidence on Hayek's theories

All the market field experiments satisfy conditions (a) to (e) above.

**Result 1:** Generally speaking, the competitive equilibrium is attained and the gains from trade are exhausted, i.e., the Hayek hypothesis is supported.

The key studies are List (2004a) and List and Price (2006), though we will discuss some important counterexamples below. These are framed field experiments in two naturally-occurring trading environments: a sports card market and a pin collector's market.

In the sports card markets, the experiment departs from laboratory status by employing the following features. First, the commodity being traded was a baseball card (though market costs and values were induced in the usual manner; see Smith 1965). Second, the trading institution corresponded to real sports card markets: sellers would have individual, six-foot desks at which they would display their wares, and buyers would move around and would bargain multilaterally. Third, the participants were given roles in which they had real experience: buyers were experienced buyers and sellers were experienced sellers.<sup>8</sup> Fourth, in addition to being experienced in their roles, traders had endogenously selected into their roles.

To ensure adherence to conditions (a) to (e), the number of traders did not exceed 24. Some of the markets were symmetric 'scissors', while others were asymmetric and had either supply or demand as

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<sup>8</sup> In sports card markets, the sellers are dealers: they rent tables in the exhibitions. Buyers are more casual participants, paying a small entrance fee and typically possessing less knowledge and experience in the market.

perfectly elastic at the equilibrium price. In List and Price (2006), some of the sessions had a smaller number of sellers than buyers, but each seller was selling multiple units (in all other sessions, each trader was looking to buy/sell exactly one unit).

The pin collector's markets were analogous subject to some simple differences. First, the traded commodity was a pin typically traded in that market. Second, the subject pool was dominated by women (in contrast to the male-dominated sports card markets). Third, the sessions had a smaller number of traders.

Setting aside some important exceptions that we will discuss below, List (2004a) and List and Price (2006) generally found that prices converged to competitive equilibrium prices and that the gains from trade were largely realized.

List (2004a) found that in sessions with inexperienced children acting as the traders, prices were less likely to be competitive and efficiency was lower. On the surface, this appears to contradict the Hayek hypothesis; yet closer inspection reveals the reverse. Hayek (1945) argued that a crucial component of market mechanism was the natural selection it imposed upon traders: poor traders would be eliminated and superior traders would survive (and thrive). When we restrict our attention to markets that have already selected out their poor performers, the Hayek hypothesis holds firm. Moreover, even within the sessions that involve endogenously selected roles and experience levels, List (2004a) found that more experienced traders tended to secure larger earnings. These results also highlight the benefits of complementing laboratory data with field data.

**Result 2:** Entrepreneurs generally move markets towards the competitive equilibrium and drive the realization of the gains from trade.

We can use experience and professionalism as proxies for being an entrepreneur, especially in light of the evolutionary selection pressures that Hayek argues are produced by markets. Consequently, several field experiments provide evidence for the hypothesis that entrepreneurs aid in the realization of the gains from trade.

Loss-aversion and the endowment effect (Tversky and Kahneman 1991) are considered cognitive biases that potentially impede trade. They diminish the likelihood that sellers agree to sell goods that have been in their possession. This is particularly relevant given the emphasis that Hayek places on arbitrage in pushing markets towards equilibrium and in realizing the gains from trade.

By conducting framed field experiments in sports card markets, List (2003, 2004b) demonstrated that, in line with standard results from laboratory experiments, inexperienced traders suffered from the endowment effect. More importantly, List (2003, 2004b) demonstrated that experienced traders suffered much less from the endowment effect (especially in the case of the goods they professionally traded), with the most expert traders not suffering from the endowment effect at all.<sup>9</sup>

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<sup>9</sup> Given a negative correlation between experience and the endowment effect in naturally occurring data, one wonders whether this represents selection (traders who suffer from the endowment effect fail) or treatment



A recent and spectacular demonstration of market inefficiency has been the housing and asset bubbles associated with the financial crisis of 2007. In a series of laboratory experiments, Smith et al. (1988) studied asset markets and found that bubbles were a common occurrence. By recruiting subjects from the Chicago Board of Trade, Alevy et al. (2007) were able to conduct complementary framed field experiments in the spirit of List (2003, 2004b). They found that in addition to being less loss-averse than their inexperienced counterparts, professional traders were also less likely to form the cascades that generate bubbles. Bubbles still formed, but the presence of entrepreneurs clearly aided in the realization of competitive prices and securing the gains from trade. Haigh and List (2009) also found that professional traders are less loss-averse than inexperienced traders.

The markets considered thus far are double auctions: both buyers and sellers can propose prices.<sup>10</sup> Conventional auctions are markets where only one side (usually occupied by a single trader) sets prices. As has been extensively demonstrated in laboratory experiments (see Thaler 1988), auctions with a common, uncertain value often result in the winner's curse, i.e., the buyer paying an inefficiently large sum for the good, and hence a failure to realize the gains from trade.

By conducting a series of framed field experiments using professional auction participants in a sports card market, Harrison and List (2008) were able to demonstrate that expert traders do not suffer from the winner's curse even though inexperienced traders did.

List and Price (2006) presents mixed evidence on the hypothesis that entrepreneurs push markets towards equilibrium (Hypothesis 2). It is again a framed field experiment in the vein of List (2004b), though the sellers (who are expert traders) are more concentrated than buyers: there are four sellers each trying to sell three units, vs. 12 buyers who are trying to purchase one unit each. Before the start of each session, the sellers are afforded the opportunity to gather privately and collude.

The authors find that under certain conditions, the collusion among experienced traders is anti-competitive, forcing the price above equilibrium and preventing efficient trade.<sup>11</sup> This is evidence against Hypothesis 2. However having buyers who are experienced reverses this and lends support to the Hypothesis 2; the experienced buyers are able to successfully thwart the collusion by the experienced sellers.

It is tempting to conclude that the pattern of results about experience and outcomes in List and Price (2006) is easily generaliseable, but List (2002) finds otherwise. Using market structures similar to those considered in List (2004a), but varying the experience of traders, List (2002) finds that trade and efficiency is highest when *one* side of the market contains experienced traders, and efficiency and trade is lowest when *both* sides of the market contain experienced traders. Thus there are important contexts where Hayek's theories about the effect of entrepreneurs are not supported by the data.

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(experience causally reduces the endowment effect). List (2003) investigates this using panel data and finds support for the treatment explanation.

<sup>10</sup> The markets differ, however, in how widely and quickly the information about bids and offers diffuses. For example in List (2004a), only traders within earshot of the price-setter are aware of a bid/offer.

<sup>11</sup> The specific condition is when trade prices are fully disclosed (rather than being noisily disclosed). We expand upon this below.

**Result 3:** There is some evidence that dissemination of price information can push markets towards *away* from competitive equilibrium and can *impede* the realization of the gains from trade.

In the seller-concentrated, collusive markets of List and Price (2006), the authors considered two treatments: a baseline, where trade prices were disclosed to all sellers with complete accuracy, and a treatment where (collusive) sellers only received noisy signals about trade prices. As long as buyers were not too experienced (see Result 2 above), then perfect price revelation led to anti-competitive and inefficient prices (since it allowed sellers to monitor the behavior of cartel members), while noisy prices generated efficient outcomes. When buyers are experienced, treatment and baseline both deliver efficient outcomes.

To the best of our knowledge, this is the only field experiment in which an investigator has experimentally manipulated the dissemination of price information. Since the context is very narrow, we are cautious in generalizing the conclusion to other, more frequently-occurring contexts (such as those considered in List 2004a).<sup>12</sup>

**Result 4:** There is mixed evidence on the ability of reputation to solve asymmetric information problems.

List (2006) is a field experiment that exploits variation in the availability of third-party enforcement in sports card markets. Ungraded sports cards are collector's items with uncertain quality. In some of the markets in which List (2006) collected data, costly third-party quality certification is available to sports card traders. As a result of their experience, professional sellers typically possess private information (compared to inexperienced buyers) about the quality of an ungraded sports card. This asymmetric information can potentially impeded efficient trade (Akerlof 1970).

List (2006) created a field analogue to the trust game (Berg et al. 1995) by having buyers approach professional sellers and offer an experimentally controlled amount in exchange for an ungraded sports card. At the time of the purchase, quality is unobservable to the buyer, but if third party certification is available, the buyer can potentially verify quality after the completion of the transaction. For trade to be efficient, quality should be increasing in the price offered by the buyer.

List found that when ex post third party verification was available, locally-based professional sellers responded to higher offers with higher quality cards. List demonstrated that this was the result of sellers fearing the adverse reputational consequences of selling poor-quality cards at a high price. Thus this part of the study supports Hypothesis 4.

List was able to conclude that reputation was solving asymmetric information problems precisely because it was failing to do so for some traders. He found that prior to the availability of third party certification, professional sellers consistently sold low quality cards regardless of the price offered.

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<sup>12</sup> In Chamberlin (1948), decentralized markets with limited diffusion of price and bid/offer information failed to converge to the competitive equilibrium. Smith (1962, 1965) did converge to the equilibrium principally because of the publicity of information on prices, bids and offers (the market institution was a double oral auction). In our opinion, this is a much more generalizeable context of the effect of transmitting additional price information.

Moreover following the introduction of third party certification, professional sellers who were not from the area (sports card exhibitions are national events with many local and non-local participants) continued to make quality unresponsive to price, further impeding efficient trade.

Online retailers (such as eBay) have become a useful environment for running field experiments since researchers can pose as sellers without the formal apparatus required for conventional retail. Jin and Kato (2006) examine the effect of the eBay reputation system on sports card trading. Similar to the sports card conventions studied in List (2006), their environment is characterized by professional sellers who have private information about card quality that can be verified ex post using third party certifiers. The authors find that a seller's online reputation (denoted by average ratings by buyers) is positively correlated with seller honesty; highly-rated sellers made less outlandish claims about unobserved quality.

Resnick et al. (2006) demonstrated that eBay's reputational system allowed highly-rated sellers to charge higher prices. They did this by having existing, highly-rated sellers sell their wares (vintage postcards) under new, low-reputation identities at the same time as under their regular identifies. Buyers' willingness to pay was substantially higher under the high-reputation identity.

Jin and Kato's (2006) study also generated evidence against Hypothesis 4. Higher-rated sellers did indeed display lower probability of delivery and counterfeit delivery. However conditional on completed sales, higher-rated sellers did not attract higher bids by buyers, suggesting that the reputation system was insufficiently strong to make quality and price positively related (and hence solve problems of asymmetric information).

## 5. Conclusion

Viewed through Vernon Smith's (1982) lens, Hayek's theories yield multiple testable hypotheses, the most important of which is the ability of the market to deliver competitive prices and efficient outcomes despite price-setting, the presence of rampant, imperfect information and the absence of central market direction. Smith (1982) examined the laboratory evidence and found strong support for the Hayek hypothesis.

Market field experiments are a complementary source of evidence that did not exist at the time of Smith's review. A key advantage of field experiments is that they allow us to test a wider range of Hayek's hypotheses, especially those that relate to the role of entrepreneurs and the effect of reputation.

We find that in general, market field experiments support Hayek's theories. Most significantly, and reassuringly given Smith's (1982) findings, the Hayek hypothesis seems as robust in the field as it is in the laboratory. We also find multiple dimensions of evidence supporting Hayek's proposition that entrepreneurs are a key force in driving markets to equilibrium and in realizing the gains from trade.

There is a rich tradition among neoclassical economists of studying price dynamics and the market process. Somewhat surprisingly, the theoretical literature of the last 30 years has paid little attention to Hayek's theories, though undoubtedly this is at least partially a consequence of the difficulty of tractably formalizing them. Nevertheless we hope that in concert with Smith (1982), this study encourages theorists to re-examine Hayek's theories.

We also find that some of the field experimental data is less supportive of Hayek's theories. There is evidence that reputation cannot alone solve problems of asymmetric information, and the (admittedly very narrow) evidence on the effect of disseminating price information poses questions of Hayek's claim that it promotes efficient trade.

In the case of the more weakly supported theories, are we to conclude that Hayek was simply wrong? Can his theories be refined in response to the findings? Perhaps the data presented are poor tests of Hayek's theories, or they are unrepresentative of market processes in general. We leave these questions to future research.

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