Market Competition and Selection

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> Realized profits, not *maximum* profits, are the mark of success and viability. It does not matter through what process of reasoning or motivation such success was achieved. The fact of its accomplishment is sufficient. This is the criterion by which the economic system selects survivors: those who realize *positive profits* are the survivors; those who suffer losses disappear.
>
> Alchian (1950)

1 Introduction

Most economic models make use of extreme rationality hypotheses: firms maximize profits with full knowledge of their technology and prices, and, investors are subjective expected utility maximizers whose beliefs are correct. Surely, some firms and some investors do not always behave as these models hypothesize. But does this matter for predictions of market outcomes? It could be that the aggregation that takes place in supply and demand results

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in prices and market quantites that agree with the predictions of models using extreme verions of rationality. It could be that over time, firms and investors learn to behave as these models predict and so over time market outcomes converge to those predicted by the models. Finally, it could be that markets select for firms and investors who behave 'as if' they are rational. This last defense of the use of rationality is the essence of the quote from Alchian (1950).

There is a long history in economics of using market selection arguments in defense of rationality hypotheses. The early literature focused on selection for profit maximizing firms. Among its best known proponents is Friedman (1953): 'The process of natural selection thus helps to validate the hypothesis (of profit maximization) or, rather, given natural selection, acceptance of the hypothesis can be based largely on the judgment that it summarizes appropriately the conditions for survival.' Of course, even if the selection reasoning is correct, selection can only work over those types of behaviors which are present in the economy. If no firm maximizes profits, then no profit maximizing firm can be selected. Alchian (1950) was acutely aware of this: 'The pertinent requirement—positive profits through relative efficiency—is weaker than 'maximized profits,' with which, unfortunately, it has been confused. Positive profits accrue to those who are better than their actual competitors, even if the participants are ignorant, intelligent, skilful, etc. The crucial element is one's aggregate position relative to actual competitors, not some hypothetically perfect competitors. As in a race, the award goes to the relatively fastest, even if all the competitors loaf.' Enke (1951) argued that, at least in competitive industries, the relatively fastest will in fact be profit maximizers, and so, in this case selection will lead to the survival only of profit maximizing firms: 'In the long run, however, if firms are in active competition with one another rather than constituting a number of isolated monopolies, natural selection will tend to permit the survival of only those firms that either through good luck or great skill have managed, almost or completely, to optimize their position and earn the normal profits necessary for survival. In these instances the economist can make aggregate predictions *as if* each and every firm knew how to secure maximum long-run profits.'

Similar market selection arguments have been proposed to justify strong rationality hypotheses on the part of investors. Fama (1965) argues

that: '...dependency in the noise generating process would tend to produce 'bubbles' in the price series... If there are many sophisticated traders in the market, however, they will be able to recognize situations where the price of a common stock is beginning to run up above its intrinsic value. If there are enough of these sophisticated traders, they may tend to prevent these 'bubbles' from ever occurring.' According to Fama, 'A superior analyst is one whose gains over many periods of time are *consistently* greater than those of the market.' This is at least indirectly an argument for market selection and its affect on the efficiency of prices. Cootner (1964) was an early, clear proponent of this argument: 'Given the uncertainty of the real world, the many actual and virtual traders will have many, perhaps equally many, forecasts... If any group of traders was consistently better than average in forecasting stock prices, they would accumulate wealth and give their forecasts greater and greater weight. In this process, they would bring the present price closer to the true value.'

In this entry we examine the more recent work which has analzyed whether these arguments for market selection, and its impact on efficiency, are correct. We consider in turn, selection over firms, and, selection over investors.

2 Selection over Firms

The argument made by Alchain, Friedman, and Enke is that a profit dynamic will select for firms that for whatever reason maximize profits. Correspondingly, according to this argument, those who do not act as profit maximizers will be driven out of the market. But how is it that non-maximizers are driven out? The implicit idea is that in the presence of maximizers, the non-maximizers experience losses which deplete their financial capital, and this forces them out of the market. The literature has explored two avenues by which losses of financial capital could have this effect. One is that if the firm's operations are financed from retained earnings, then firms which consistently experience losses would eventually exhaust their retained earnings causing them to vanish. A second argument is that unsuccessful firms will not be able to raise capital in the financial markets, and may not even be

able to retain their initial capital. Thus, so this story goes, the markets will punish unsuccessful firms and they will eventually vanish.

Winter (1964, 1971) and Nelson and Winter (1982) analyze a retained earnings dynamic. They argue that the retained earnings of profit maximizers will grow fastest, and thus these firms will eventually dominate the market. Nelson and Winter construct a partial equilibrium model in which the "as if" hypothesis of profit maximization describes the long run steady state behavior of firms. In their analysis, prices are fixed and all firms have access to the same technology. This structure leads to the existence of a uniformly most fit firm which is selected for by a retained earnings based investment dynamic.

The early work on market selection was greatly concerned with the meaning of profit maximization when profits are random. Dutta and Radner (1999) directly take up the question of whether markets select for firms that maximize expected profits. Their answer is no: the decision rules which maximize the long probability of survival are not those that maximize expected profits. Dutta and Radner's firms are owned by investors who choose how much of the firm's earnings to reinvest in the firms and how much to withdraw as dividends. An expected profit maximizing firm is one which maximizes the expectation of present discounted value of dividends paid to its owners. This policy results in an upperbound on the retained earnings left in the firm and from this level of retained earnings any firm can experience a string of losses that result in bankrupcy.

There are two parts to the argument for market selection of profit maximizers. First, there is the issue of whether the market selects for profit maximizers. Second, there is the issue of whether in the long run the economy behaves as if only profit mazimizing firms exist. The Dutta and Radner analysis raises doubts about a positive answer to the first question in stochastic settings. Koopmans (1957) raised doubts about a positive answer to the second question even in a determnistic setting. According to Koopmans, appealing to an external dynamic process to defend the profit maximization assumption is not a satisfactory way to proceed. Instead, he believed that the dynamic process itself should be modeled. Nelson and Winter (1982, p. 158) were also aware that the coevolution of firm behavior and the economic environment resulting from a complete model of the dynamic process could pose

problems for the evolutionary defense of profit maximization. They observed that among the "...less obvious snags for evolutionary arguments that aim to provide a prop for orthodoxy ..." is "...that the relative profitability ranking of decision rules may not be invariant with respect to market conditions." They do not, however, go on to provide a general equilibrium analysis of the consequences of replacing static profit maximization with a selection dynamic.

Blume and Easley (2002) showed that Koopman's concern about the market selection dynamic in a general equilibrium setting is correct. They show that although only profit maximizers persist in any steady state of the retained earnings dynamic, the long run of the economy need not be well described by assuming that only profit maximizing firms exist. The difficulty arises because of the endogeniety of prices which causes the relative profitability of firms to depend on the allocation of capital across the firms. As a result, the retained earnings dynamic need not settle down, and efficient firms can be driven out of the market by inefficient firms.

In addition to raising working capital through retained earnings, firms also enter the capital markets. Whether these markets reinforce the market selection hypothesis, as Friedman argues, or undermine it, depends on how well these markets function. If markets are complete (without the securities created by non-maximizing firms) and investors are expected utility maximizers with rational expectations, then investors would not allocate capital to non-maximizing firms. Such firms would never produce, and the the selection hypothesis would be trivially, and instantly, correct. Alternatively, if some investors have incorrect expectations, then they could invest in non-maximizing firms. The fate of these firms depends on the fate of their investors. So in this case, the question of selection for profit maximizing firms reduces to the question of selection for investors who act as expected utility maximizers with rational expectations.

3 Selection over Investors

Friedman, Fama and Cootner argue that asset markets will select for rational investors, and that because of this selection, assets will eventually be priced

efficiently. Two interesting approaches have been taken to the selection for rational investors question. First, suppose traders use a variety of portfolio rules. Is it the case that traders whose rules are not rational rules will lose their money to those who do act as if they are rational? Second, suppose that all traders are subjective expected utility maximizers. Is it the case that markets select for those whose expectations are correct, or most nearly correct?

In order to pose these questions precisely rationality has to be defined (see RATIONALITY). The selection literature has asked about selection for a very strong form of rationality—expected utility maximization with correct expectations about the payoffs to assets. This is the interesting question because in economies populated by subjective expected utility maximizers whose beliefs are not tied down by a rational expectations hypothesis we have little to say about asset prices. Assuming only that investors are subjective expected utility maximizers (in the sense of Savage (1951)) places no restrictions on the stochastic process of Arrow security prices (Blume and Easley 2005).

3.1 Selection over Rules

Consider an intertemporal general equilibrium economy with a collection of Arrow securites and one physical good available at each date. Suppose traders are characterized by their stochastic processes of endowments of the good and by portfolio and savings rules. A savings rule describes the fraction of his wealth the trader saves and invests at each date given any partial history of states. Similary, a portfolio rule describes the fraction of his savings the trader allocates to each Arrow security. The savings and portfolio rules that rational traders could choose form one such class of rules. But other, non-rationally-motivated rules are also possible.

There are two questions to ask about the dynamics of wealth selection in this economy. First, is there any kind of selection at all? Is it possible to characterize the rules which win? Second, if selection does take place, does every trader using a rational rule survive, and in the presence of such a trader do all non-rational traders vanish?

In repeated betting, with exogeneous odds, the betting rule which maximizes the expected growth rate of wealth is known as the Kelly Rule (Kelly 1956). The use of this formula in betting with fixed, but favorable odds was further explored by Breiman (1961). In asset markets the "odds" are not fixed, instead they are determined by equilibrioum asset prices, which in turn depend on traders' portfolio and savings rules. Nonetheless, the market selects over rules according to the expected growth rate of wealth share they induce. Blume and Easley (1992) show that if there is a unique trader using a rule which is globally maximal with respect to this criterion, then this trader eventually controls all the wealth in the economy, and prices are set as if he is the only trader in the economy. A trader whose savings rate is maximal and whose portfolio rule is, in each partial history, the conditional probability of states for tomorrow has a maximal expected growth rate of wealth share. This rule is consistent with the trader having logarithmic utility for consumption, rational expectations and a discount factor that is as large as any trader's savings rate. Thus, if this trader exists, he is selected for. However, rationality alone does not guarantee a maximal expected growth rate of wealth share. There are rational portfolio rules that do not maximize fitness (even controlling for savings rates) and traders who use these rules can be driven out of the market by traders who use rules that are inconsistent with rationality.

Amir, Evstigneev, Hens, and Schenk-Hoppe (2005) and Evstigneev, Hens, and Schenk-Hoppe (2006) take an alternative approach to selection over rules in asset markets. They consider general one-period assets and ask if there are simple portfolio rules that are selected for, or are evolutionarliy stable, when the market is populated by other simple (not explicitly price dependent) portfolio rules. In this research, either all winnings are invested, or equivalently investors are asssumed to invest an equal fraction of their winnings. So selection operates only over portfolio rules. Amir, Evstigneev, Hens, and Schenk-Hoppe (2005) find that an investor who apportions his wealth across assets according to their conditional expected relative payoffs drives out all other investors as long as none of the other investors end up holding the market. This result is consistent with Blume and Easley (1992) as the log optimal portfolio rule agrees with the conditional expected relative payoff rule when only these two rules exist in the market. Hence, both of these rules end holding the market in the limit. Evstigneev, Hens, and Schenk-Hoppe (2006) show that the expected relative payoffs rule is evolutionarily

stable using notions of stability from evolutionary game theory.

3.2 Selection among Subjective Expected Utility Maximizers

DeLong, Shleifer, Summers, and Waldmann (1990) and DeLong, Shleifer, Summers, and Waldmann (1991) analyze selection over traders who are subjective expected utility maximizers with differing beliefs. DeLong, Shleifer, Summers, and Waldmann (1990) shows, in an overlapping generations model, that traders with incorrect beliefs can earn higher expected returns. They do so because they take on extra risk. But as survival is not determined by expected returns, this result does not answer the selection question. DeLong, Shleifer, Summers, and Waldmann (1991) argues that traders whose beliefs reflect irrational overconfidence can eventually dominate an asset market in which prices are set exogenously. This result appears to contradict Alchian's and Friedman's intuition. But, as prices are exogeneous, these traders are not really trading with each other; if they were, then were traders with incorrect beliefs to dominate the market, prices would reflect their beliefs and rational traders might be able to take advantage of them.

In an economy with complete markets, and traders who have a common discount factor, Alchain and Friedmans's intuition is correct. Sandroni (2000) shows, in a Lucas trees economy, with some rational-expectations traders that, controlling for discount factors, all traders who survive have rational expectations. Blume and Easley (2006) show that this result holds in any Pareto optimal allocation in any bounded classical economy, and thus for any complete markets equilibrium. To see why the market selection hypothesis is true for these economies suppose that states are iid and that traders have differing, fixed iid beliefs. Then each trader assigns zero probability to almost all the infinite sample paths that any other trader believes to be possible. Each trader would be willing to give up all of his endowment on the sample paths he believes to be impossible in order to obtain more consumption on those he believes to be possible. Since markets are complete, these trades are effectively possible. But, if only one trader has correct beliefs, then only one trader puts positive probability on the infinite sample paths that actually occur. So only this trader will have positive consumption, and

thus positive wealth, in the limit.

For bounded complete markets economies there is a survival index that determines which traders survive and which traders vanish. This index depends only on discount factors, the actual stochastic process of states and traders beliefs about this stochastic process. Most importantly, for these economies, attitudes toward risk do not matter for survival. The literature also provides various results demonstrating how the market selects among learning rules. The market selects for traders who learn the true process over those who do not learn the truth, for Bayesians with the truth in the support of their prior over comparable non-Bayesians, and among Bayesians according to the dimension of the support of their prior (assuming that the truth is in the support).

In economies with incomplete markets, the market selection hypothesis can fail to be true. Blume and Easley (2006) shows that if markets are incomplete, then rational traders may choose either savings rates or portfolio rules that are dominated by those selected by traders with incorrect beliefs. If some traders are irrationally optimistic about the payoff to assets, then the price of those assets may be high enough so that rational traders choose to consume more now, and less in the future. Their low savings rates are optimal, but as a result of their low savings rates the rational traders do not survive.

An alternative version of the market selection hypothesis is that asset markets select for traders with superior information. The research discussed above asks about selection over traders with different, but exogeneously given, beliefs. Alternatively, if traders begin with a comon prior and receive differential information they will have differing beliefs, but now they will care about each others beliefs. In this case, the selection question is difficult because the information that traders have will be reflected in prices. If the economy is in a fully revealing rational expectations equilibrium, then there is no advantage to having superior information, see Grossman and Stiglitz (1980). So the question only makes sense in the more natural, but far more complex, case in which information is not fully revealed by market statistics. Figlewski (1978) shows that traders with information which is not correctly reflected in prices have an advantage in terms of expected wealth gain over those whose information is fully impounded in prices. But as ex-

pected wealth gain does not determine fitness this result does not fully answer the question. Mailath and Sandroni (2003) consider a Lucas trees economy with log utility traders and noise traders. They show that the quality of information affects survival, but so does the level of noise in the economy. Scuibba (2005) considers a Grossman and Stiglitz (1980) economy in which informed traders pay for information and shows that in this case uninformed traders do not vanish.

4 Conclusion

The modern literature has shown that the market selecion hypothesis needs to be qualified. For some economies it acts much as the earlier writers conjectured; in others it does not select for profit maximizers or rational traders. Much work remains to be done, however. Blume and Easley (1992) and Sandroni (2000) mostly discuss selection in complete markets. Sandroni, however, points out that even when markets are incomplete, traders with log utility and rational expectations are favored, while Blume and Easley construct some examples to show that the outcome of market selection can depend on market completeness. The connection between market structure and market selection is not well-understood. The implications of market selection for asset pricing are known only for complete markets in the long run and some examples. Most economists' intuition about market behavior and asset pricing comes from the study of market models which allow little or no agent heterogeneity. Taking heterogeneity seriously and chasing down its implications for market performance promises to be a rich area for future research.

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