

TWO MODELS OF SPECULATION AND INFORMATION

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In a recent *ECONOMETRICA* paper, Jean Tirole [1982] asserted that what he called the Working-Hirshleifer-Feiger view of speculation was "internally inconsistent." His article goes on to present an alternative theoretical structure. The two competing formalizations differ interestingly in their modelling of the information-generation-plus-acquisition process, and it is this aspect that I mainly discuss here. I also will compare certain other features of the models. As to the accusation of internal inconsistency, I prefer to regard this as a momentary instance where ardent Gallic élan ("De l'audace, encore de l'audace, et toujours de l'audace" — Danton) has temporarily overbalanced Gallic cautionary bon sens ("N'ayez pas de zèle" -- Not too much zeal, guys -- Talleyrand). In response I take my stand with the Duke of Wellington: "There is no mistake; there has been no mistake; and there shall be no mistake."¹

Turning now to the main issue, here are the key points in the information modelling represented by what I shall call the Hirshleifer-Salant-Feiger (HSF) theory.² Think of events as occurring at three points of time, sufficiently

¹Referring only to my own papers [Hirshleifer (1975, 1977)], plenty of opportunity was offered a critic to demonstrate inconsistency, were it present, by showing that the conclusions — in the analysis, the geometry, or the detailed numerical examples — did not follow from the premises. Tirole has not shown this. In a move suggested by Tirole's "seminar speaker" tale (his p. 1164), I hereby offer to bet a 1-year subscription to *ECONOMETRICA* that he cannot demonstrate any internal inconsistency. Furthermore, as will become evident in footnote 4 below, this défi américain is no mere gasconade. Following Tirole's own logic, it is actually a kind of ontological proof of the validity of my argument!

²I use this label to call attention to the exchange in the Quarterly Journal of Economics [Feiger (1976), Salant (1976), Hirshleifer (1976)] which clarified, corrected, and generalized my original paper. I do not feel justified in conscripting the name of Holbrook Working as another big gun on my

close together so that no time-discounting is required:

- (1) PRIOR ROUND OF TRADING. Here individuals with exogenously given portfolio endowments, tastes, attitudes toward risk, and generally differing prior probability beliefs (as to the content of public information to come) revise their endowed portfolios via market trading. (But consumption does not yet occur.) All such prior-round trading takes place at market-clearing prices.
- (2) EMERGENCE OF INFORMATION. The public information anticipated in #1 above, for example, an authoritative government report about the prospective size of the wheat crop, now emerges, leading traders to revise their probability beliefs about the demand or supply of one or more commodities. In the extreme case (the only case I will consider further here) the information is conclusive, so that all traders must now agree in attaching probability of unity to one state of the world (one size of crop), probability zero to all other states.
- (3) POSTERIOR ROUND OF TRADING. Guided by their revised beliefs, traders go on to make their final revisions of portfolios (now under conditions of certainty, if the information-event was indeed conclusive). Again, all trades take place at market-clearing prices. Consumption then follows.

Before turning to how Tirole pictures information arrival, I should say something about the general structures of the competing formulations. The HSF model is one of general equilibrium: individuals start with endowments, preferences, etc., and end up choosing patterns of consumption that maximize utility. Tirole's is an extreme partial-equilibrium "pure trading" or (he sometimes says) "purely speculative" model. In his world no-one produces or consumes. In fact no-one has any intrinsic interest whatsoever in supplying

side of this clash, although Working has kindly corresponded with me on these issues. For, while the main thrust of the HSF theoretical results do tend to support his observations and insights relating to speculative markets, Working has never specifically endorsed the models in question.

or demanding commodities. Each person is simply looking for a chance to buy for less in order to sell for more — with the aim of maximizing "expected monetary gain" (if he is risk-neutral) or some risk-discounted adjustment thereof (if he is risk-averse). I shortly will say more about how this incompleteness à outrance of the Tirole model distorts the analysis. But his model of information is in principle separable from this unsatisfactory feature, i.e., it could be incorporated into a more general theory.

While Tirole later generalizes his theory to a multi-date ("dynamic") version, his basic objection to the HSF model arises in his simplest 1-date ("static") model. Limiting attention to this case, therefore, his assumed sequence of events appears to be:

(1) PRIOR ROUND OF TRADING. There is no prior round of trading. (I.e., no trading occurs before arrival of information.)

(2) EMERGENCE OF INFORMATION. For Tirole, information arrives via a set of private signals (about the price vector p) received by the separate traders. While all traders have agreed prior beliefs, their generally heterogeneous signals should, it might seem, lead to differing posterior beliefs. (Mais non! — as will be shortly seen.)

(3) POSTERIOR ROUND OF TRADING. Everything of interest takes place here. More specifically, as in the Sherlock Holmes story what is of interest is that nothing takes place: there is no trading in the posterior round either!

Even in a strange world with no productive or consumptive motives for trading, this result may seem surprising, in view of the aforesaid differences in beliefs once traders have received their private signals. The explanation, and Tirole makes a valid contribution here, is that there is another source of information not yet accounted for: the very willingness of others to trade tells me something about the state of the market. And specifically, following

a theme anticipated in Akerlof (1970) and Grossman and Stiglitz (1976) and the adverse-selection literature generally, the visible eagerness of others to trade may (not must as Tirole claims) be sufficient basis for me not to do so. To see how this works out one would have to specify, more fully than did Tirole, something about intra-period market "dynamics" in the proper sense of the word, i.e., about the transient path that price might take before settling down to an equilibrium level.³

Imagine a Walrasian auctioneer who cries out price au hasard. Suppose that I am a trader, named Hercule Poirot, and that the initial price strikes me as too low in the light of my private signal. I decide to buy, and look for someone willing to sell. Imagine that I find a trading partner. So far so good. But then (the reasoning of course follows Aumann [1976]), I say to myself: "Attendez, mon vieux. Since we both, lui et moi, had the same priors, and since neither of us has any trading motive other than turnaround profit, he must have received an informative private down signal just as I was receiving my informative private up signal. Before finalizing my decision I should take account of this information of his which I have thus so cleverly

³Tirole unfortunately employs the terms "statics" and "dynamics" in a non-standard way. His "dynamics" refers to multi-date analysis, his "statics" to single-date analysis. This provides no terminology for the needed distinction between the analysis of equilibrium states and the analysis of transient paths or oscillations. In the standard terminology, we use "comparative statics" to analyze how a change in parametric underlying conditions modifies the equilibrium attained; we use "dynamics" if we are concerned with the specifics of the transition path. This distinction is quite crucial for the current discussion. For, in comparative-static analysis, a price change can only occur in consequence of underlying changes in supply or demand conditions -- a key point in the HSF model. But Tirole is basically concerned with "pure" price fluctuations (such as might emerge in the theory of "bubbles"), where mutually interacting anticipations about the prospective movement of prices of themselves (i.e., without any exogenous change in supply-demand determinants) feed back into the very price path thus generated.

deduced." En effet, his very willingness to sell makes me, Hercule, now less willing to buy. The other party, reasoning the same way, will similarly be less willing to sell. This mutual reculement, carried to the limit, dictates that in the end, no-one buys or sells.⁴

But Tirole's conclusion, that this process leads inevitably to agreed beliefs and thus to non-trading, is not in general valid. For one thing, and Tirole concedes this, traders' priors may differ -- indeed, in the real world they surely will. For another, if information generation and dissemination are "noisy," not all relevant information is perfectly revealed by price, hence not all differences of belief can ultimately be eliminated (Diamond and Verrechia [1981]). Thus, the parties may after all "agree to disagree" -- i.e., they will trade as assumed in the HSF models.

Returning to a comparison of the theories, it should be evident that a model whose implication is that no trading at all ever occurs is disastrously inadequate! Tirole therefore wisely turns (p. 1168) to what happens when his assumptions are relaxed. Some of his relaxations are uninteresting, e.g., introducing irrational or risk-preferring agents, but others do point the way toward more satisfactory theories.

The most important relaxation occurs when Tirole abandons the assumption rather obscurely described as "absence of correlation between the initial position of traders and the market outcome." What this means is that Tirole would now admit into his world the fact that people have supplies of and demands for commodities, and so are interested in something other than

⁴Thus, by his own logic, and following his "seminar speaker" tale, Tirole must now concede that I am correct! My unconditional willingness to bet (see the challenge in footnote 1), according to his theory, must make him recoil -- leaving me in sole command of the field, like Napoleon at Austerlitz.

achieving trading gains. Cela va sans dire, one would have thought, but the improvement is welcome indeed. Tirole draws from this relaxed model the inference that the market can provide price insurance to traders with risky positions. So the analysis (he says) "vindicates the Keynes-Hicks position" that speculative trading is a way to hedge price risks.

So far, so good. Tirole is now en route toward a model that at least begins to make contact with speculative behavior. And, certainly, the Keynes-Hicks price-insurance theory does represent a part of the story. Nevertheless, Tirole seems utterly unaware that, when we turn to a world with real supplies and demands, the Keynes-Hicks analysis has a great flaw: it fails to incorporate the fact that individuals face quantity risks as well as price risks (on this see also McKinnon [1967]).

Consider a wheat farmer. It is certainly true that, so long as the size of the aggregate crop is unknown, he faces price risk. Thus, other things equal, he would indeed want to insure against this price risk, which he can do by selling at a known price for future delivery (i.e., by going "short" in the futures market). But, as explained in the HSF theory, other things are not equal. The wheat price is stochastically high, ordinarily, just when the typical farmer's physical wheat crop is stochastically small. Thus it is not at all clear that wheat farmers will want to "hedge" the price risk by selling short. Price risk is inversely correlated with and therefore tends to balance out exposure to quantity risk.

In contrast with the emptiness of the Tirole theory, and with the single-factor explanation provided by the Keynes-Hicks view, the general-equilibrium modelling of the HSF theory points to a number of interacting elements that help determine speculative trading. The HSF papers emphasized that the wheat farmer's willingness to trade in the prior round depends importantly upon his

beliefs (and particularly their deviation from typical beliefs in the market) as well as upon his risk-tolerance. Later analysts pursuing the same or similar general-equilibrium approaches have demonstrated the significance of other factors as well: the covariance of the farmer's own risky output with the market totals, and the elasticity of wheat demand (see Anderson and Danthine [1983], D. Hirshleifer [1984]). Of course, analogous considerations will apply for the prior trading decisions of people on the other side of the market -- consumers of wheat, millers, etc. Finally, transaction costs and the scope of available markets will limit the abilities of all these agents to reach a full optimum in either prior or posterior trading.⁵

A second "relaxation" of interest concerns the postulate of identical priors. Tirole concedes the point that, where prior beliefs are not identical, trading would occur even in his arid "pure trader" regime. So the Holbrook Working interpretation of speculative trading based on divergent beliefs, so airily dismissed by Tirole earlier on, does reappear after all.

As Marshal Foch was wont to say, "De quoi s'agit-il?" -- What's the bottom line? Tirole's paper is really an essay about single-market transient price paths. It asks essentially whether, given the possible characteristics of such price paths, traders in a zero-sum game can make money off other

⁵A side-issue that might usefully be cleared away here concerns the distinction between a theory or model versus a particular application of that theory to an actual situation. Tirole is incorrect when he asserts that the HSF authors had a "theory" that differences in belief are the key to speculative behavior, and that risk-tolerance affects only the size of their chosen gambles. These inferences emerge from the HSF theoretical structure only in a special class of instances based on specifying plausible data, functional forms, and/or other restrictions. In particular, my papers pointed out that the inference in question follows strictly only under quite severe specifications: among them, that all utility functions are separable in the commodities, and that all producers have perfectly correlated outputs. (Nevertheless I hazarded the conjecture that, even though these conditions surely did not exactly apply, the inferences remain approximately valid.)

traders on the basis of differing private signals, the answer being negative in a particular idealized model. The HSF papers are in drastic contrast. They ignore transient price paths, and describe the relationships that must hold between prior and posterior prices in a general-equilibrium comparative-static model — the prior/posterior dating being relative to the arrival of a public signal freely available to all traders.

The lines of thought here are so dissimilar that they can scarcely be said even to be in disagreement. Tirole postulates private signals, the HSF papers a public signal; Tirole deals with transient paths, HSF with comparative statics; Tirole employs an extremely narrow partial-equilibrium ("pure trading") approach, the HSF papers develop a general-equilibrium model in which consumption and production and beliefs as to the content of forthcoming information are what ultimately motivate trade. Yet there is one respect in which Tirole's analysis is the more general, to wit, in making traders' anticipations about prices endogenous rather than exogenous. This is certainly a valid contribution, which should be incorporated into a truly general theory that would cover both comparative statics and the dynamic transient path of market trading. Awaiting such a cosmically satisfying development, the immediate question is what light any of our admittedly imperfect theories casts upon actual phenomena. I will accentuate the positive here only by mentioning two recent and ongoing studies that have fruitfully employed the HSF model: Salmon [1984] and D. Hirshleifer [1984].

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