

SECTION 4. MANAGEMENT

DOI: <https://doi.org/10.30525/978-9934-26-159-6-19>

ON THE VALUE OF INFORMATION

Dr. Michel Verlainé

ICN Business School

Information is obviously of high importance for economic decision makers. In financial economics, equilibria are typically analysed without frictions, namely taxes, transaction costs and asymmetry of information. The Efficient Market Hypothesis presumes that asymmetry of information is “limited” and information is rapidly integrated into asset prices. In a famous paper, Grossman and Stiglitz (1980) showed that financial markets cannot be fully efficient as information is costly to extract and process, thus some efficiency needs to exist for asset managers to make profit on the extracted information. This leads to the fundamental question of what information is and what its value is?

To make the concept of information operational, in finance the Efficient Market Hypothesis is built around three degrees of information that should be integrated into prices. The three degrees are past prices, public information, and private information. Efficiency with respect to past prices has been largely documented. With public information, at least conceptually the problem is already more complex. Typically, it is presumed that public information is statistical macroeconomic data. It is important, however, to note that the interpretation of information is model dependent. Moreover, what about information about geopolitical events for which no statistical data exists. The information is difficult to translate into unique probability distributions and leads to what is called ambiguity. Finally, private information is information that is detained by a few decision makers, but not public. The strong form market hypothesis states that, even such private information, can be revealed by financial markets through the trading process and depends on the market microstructure. Interesting examples are documented in Lo (2017).

The different degrees of information mentioned above, however, do not answer the question of what information is and especially what the value of information is? If we want to understand the incentives for decision makers to feed information into prices, we need to understand the cost and the value of

information. The notion of information is typically analysed through Generalized Information theory (Klir, 2005) and focuses on *uncertainty-based information*. Basically, information draws its value from the reduction in uncertainty gained for a decision maker. In economics, information is modelled with signals, which in principle are costly to access. This problem was originally addressed by Blackwell (1953). Signals provide information about the likelihood of future possible states of the economy. To pin down the value of information, we need to evaluate how much a decision maker would pay to access it. The problem is that the value of information will depend on the decision makers prior information, his preferences (his utility function) and the decision problem to which the information is applied.

More recently, Cabrales, Gossner and Serrano (2013) have analysed the value of information to investors facing non-arbitrage markets. They suggest that the value of information for most decision makers with different degrees of risk aversion is provided by a reduction in entropy given the information. From a decision-theoretic viewpoint, entropy is fundamentally a measure of uncertainty in a distribution. It takes value 0 when there is no uncertainty and the value is maximal when the distribution is uniform, meaning all possible states are equally likely. Information has the most value when the states are equally likely and the information (signal) sharpens the distribution by putting more probability on some events. The expected reduction in entropy, called *entropy informativeness*, thus provides a measure of information.

In a companion paper, Cabrales, Gossner and Serrano (2017) go further by analysing the information value and the price trade-off. They show that a decision maker's demand for information is characterized by risk aversion. Less risk averse decision makers have a stronger demand for information than more risk averse decision makers. To eliminate wealth effects, they characterize uniform levels of risk aversion, independently of wealth levels. This enables them to compare the value of information normalized by the price to average indexes of risk aversion. More formally, the approach consists in ordering preferences for information and it is based on the duality approach developed by Aumann and Serrano (2008). In that sense, an information is deemed objectively more valuable if it is accepted by another decision maker who likes information more than the first, whatever his wealth level.

The measure of value of information suggested by Carbrales, Gossner and Serrano (2017) is based on the cross-entropy between the distribution with prior information and the distribution with posterior information, given the signal from the purchase of information. The cross-entropy takes value 0 when the prior distribution is similar to the posterior distribution, thus the value of information is 0. The cross-entropy “explodes” when the states have very low

(eventually 0) probabilities under the prior probability distribution and a much higher value under the posterior probability distribution. The value of information provided by the signal is then very high as it indicates the likelihood of events that were supposed to be unlikely under prior information. The *normalized value of information* purchases is calculated by comparing a function of expected cross-entropy divided by the price of the information purchase. Interestingly, this normalized value of information purchases bears a direct link with risk aversion indexes of decision makers. This implies that the distribution investors' risk aversions in a market will condition the aggregate demand for information.

The link between value of information and prices, also in the sense of research costs, seems a missing equation to better understand the degree of efficiency of financial markets. Gârleanu and Pedersen (2018) provide an interesting analysis of the degree of efficiency with heterogenous investors and asset managers. Further research on the value of information and also on information elicitation approaches such as those developed in Baillon and Xu (2021) thus seems highly promising to better understand degrees of market efficiency.

References:

1. Aumann, R.J. and Serrano, R. (2008) "An economic index of riskiness", *Journal of Political Economy*, 116, 810–836.
2. Baillon, A. and Xu, Y. (2021) "Simple bets to elicit private signals", *Theoretical Economics*, 16, 777–797.
3. Blackwell, D. (1953) "Equivalent comparison of experiments", *Annals of Mathematical Statistics*, 24, 265–272.
4. Cabrales, A., Gossner, O. and Serrano, R. (2013) "Entropy and the Value of information for Investors", *American Economic Review*, 103(1), 360–377.
5. Cabrales, A., Gossner, O. and Serrano, R. (2017) "A normalized value of information purchases", *Journal of Economic Theory*, 170, 266–288.
6. Gârleanu, N. and Pedersen, L.H. (2018) "Efficiently Inefficient Markets for Assets and Asset Management", *The Journal of Finance*, VOL. LXXIII.
7. Grossman, S. and Stiglitz, J. (1980) "On the impossibility of informationally efficient markets", *American Economic Review* 70, 393–400.
8. Klir, G. J. (2005) *Uncertainty and Information: Foundations of Generalized Information Theory*, Wiley-IEEE Press.
9. Lo, A. (2017) *The Adaptive Markets Hypothesis: Financial Evolution at the Speed of Thought* Princeton University Press.