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Nathanaël Colin-Jaeger & Thomas Delcey

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When efficient market hypothesis meets Hayek on information: beyond a methodological reading

Nathanaël Colin-Jaeger[a] and Thomas Delcey [b]

[a]ENS de Lyon, Triangle, Lyon, France; [b]Université Paris 1 Panthéon-Sorbonne, Centre d'Economie de la Sorbonne, Paris, France

ABSTRACT

Hayek and the Efficient Market Hypothesis (EMH) are often seen as proposing a similar theory of prices. Hayek is seen as proposing to understand prices as information conveyer, incorporating information during the process of competition, while EMH is defined as the fact that all information in a market is integrated into assets prices. This paper explains how a lineage between Hayek and the EMH can be illustrated while taking into account these differences. We introduce in order to defend this claim a distinction between methodological and epistemological differences: methodological differences are seen as the way an author operationalizes his broader conceptions whereas epistemology is defined as the core concepts of his theory. We particularly want to shed light on the homogeneous shift that can be identified in the epistemology of Hayek and the EMH. We conclude that this shift fleshes out the understanding that some authors have of neoliberalism.

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1. Introduction

One of the most important tenets of neoliberalism[1] is defined as the fact that the market 'posits to be an information processor more powerful than any human brain' (Mirowski & Nik-Khah, 2017, p. 54). Therefore, neoliberalism is deeply linked with the concept of information.

In this perspective many authors underline that Hayek introduced a shift in economics and politics with the introduction of the notion of information (Hirshleifer, 1973; Grossman & Stiglitz, 1976 and 1980; Mirowski 2009; Vivès, 2008, 2014), and draw a comparison with other theories, especially Efficient Market Hypothesis (EMH) in financial economics, which use information in order to characterize assets prices formation. The comparison, between Hayek and EMH, appears to be of the utmost importance since finance is also one of the main elements defining neoliberalism (Fourcarde-Gourinchas & Babb, 2002; Krippner, 2005; Duménil & Lévy, 2014; Cahill & Konings, 2017).

In this paper, we compare Hayek's theory of price and the work of Eugene Fama and Holbrook Working pioneer contributions on EMH.[2] The comparison is, at first sight, relevant: the concept of information is central in the works of Hayek, Working, and Fama, where information is the set of all relevant data for the action of individuals. EMH's theorists and Hayek use the system of prices as the way to centralize information while there can be no central planning by an individual. It could then be said that the theory of efficiency formulated by Fama (1965a, 1965b, 1970), when prices incorporate all the relevant information, is a restatement of the theory of price we can find in the work of Hayek. One may also point out the similarities in terms of consequences: Hayek and Fama defend the deregulation of the market.

CONTACT Thomas Delcey thomas.delcey@univ-paris1.fr
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While this intention appears considerable in its consequences little attention has been paid to the testing of this comparison. Most assimilations remain superficial, non-systematic or underdeveloped. For example, Vivès, in his classical book on information and learning in markets, just asserts that: 'Hayek's ideas are the basis for the rational expectations models that explain how rational agents make optimal inferences from prices, and other public statistics, about the relevant parameters about which they are uncertain' (Vivès, 2008, p. 2). A similar issue is raised by those who see Hayek as the inspiration of everything that is often vaguely called neoliberal.

But these sorts of assimilations, that draw a direct and an unquestioned line between Hayek and the more recent models using rational expectations, raise several issues. For instance, Hayek, as a systematic author, developed a particular social philosophy and philosophy of economics. How can we compare him with authors who do not have the same range of analysis and a different methodology? It is well accepted now that a lot of similarities between Hayek and other authors, for example, authors from the Chicago School, are mostly superficial (Butos, 1985, 1997; Hoover, 1988; Zijp, 1990; Mougeot, 2009). Boettke and O'Donnell (2013) highlighted the particularity of Hayek's position as a representative of the Austrian tradition, which highly differs from the position of the American school – which is Fama's school[3] – especially on the question of formalization. Some authors on this subject even wrote about two different paradigms (Audier, 2013), highlighting the very particular position of Hayek in the economic field.

Our aim in this paper is to develop the comparison between Hayek's theory and the development of EMH in finance – through the works of Working and Fama – in order to justify the lineage between these prices theories while taking into consideration their important differences. The concept of information initially called knowledge in the work of Hayek will be the central theme of our analysis.

This comparison raises several problematic issues. For instance, it is well-known that the respective position of the selected authors evolved through time (see for instance Caldwell, 2004 for Hayek, and Berdell & Choi, 2018 for Working). We will thus compare one formulation of Hayek and of the EMH. Hayek's position is formulated in several articles from 1935 to 1946, the EMH position is the standard view in the literature. This main focus on analytical matters to the detriment of historical acuity calls for further investigations, see Section 4.1 on this problem.

The thesis of this article is thus to show how bridges can be built between Hayek's theory of information and the concept of information that we find in the works of Fama and Working. We then acknowledge the literature that stresses the importance of the effective differences between Hayek and other corpuses, but we show that the similarities are hidden beyond methodological differences, often not noticed by the authors defending the continuity between Hayek's and EMH's views. Indeed, these authors share the same conception of information, broader than scientific knowledge, which leads them to the same conception of market and competition. This involves, as we will showcase, a formulation of efficiency that can be compared between Hayek and Fama. While the lineage between Hayek and Fama is sometimes taken as a self-evident fact in the literature, or criticized because the authors do not share enough in terms in methodology, we will show that this opposition can be overcome with a proper analysis of what these theories share analytically. Thus, we challenge the thesis of Boettke and O'Donnell (2013), for instance, who claim that formalist economics, especially the economics of information, missed Hayek's point because of the assumptions made for formalization. We show in this paper that if there are important differences between Hayek and EMH theorists on the assumptions made, the lineage between Hayek and EMH is more profound.

In order to overcome this problem, we propose an original distinction between methodology and epistemology to show that Hayek and EMH share important core conceptions. Epistemology encapsulates the common core of the theories, that is to say, the same conception of agent's information that implies a specific understanding of the functions and nature of the market and competition. Methodology refers to the differences in terms of operationalization between the two conceptions. See section 4 and 5 for more specifications.

Hence our main result is to highlight a common *Weltanschauung* (Mirowski, 2009, p. 112) or World Reason (Dardot & Laval, 2009; Cahill & Konings, 2017; Konings, 2018), namely a common representation of the world, especially of the market and its role, between Hayek and EMH. Another contribution of our paper is to refocus the historical and methodological literature about finance on the conception of information, rather than on the stochastic process underlying EMH's formulations.[4] Obviously, if our core conception is warranted, our paper highlights the importance of financial economics for an understanding of neoliberalism.

Section 2 is dedicated to a reconstruction of Hayek's philosophy in two subsections. The first one highlights the importance of information as a core concept. We then underline the consequences of this starting point, namely a new conception of market and competition. Section 3 develops the positions of Working and Fama. The sub-section on Working concentrates on his theory of information, while the sub-section on Fama will pay particular attention to the formulation and efficiency and the transformation of the concepts of market and competition that stem from this starting point. Section 4 defends our comparison between the two corpuses with our distinction between epistemology and methodology. Finally, section 5 provides a systematic comparison on three issues: a subjective view of information which leads to the symmetry of the observed and the observer, a specific conception of market and competition and a formulation of informational efficiency in Hayek's work.

2. Hayek, the introduction of information as a core concept

Hayek is rightly acknowledged as one of the masterminds of the liberal and economic thought and has a great influence both theoretically and organizationally (Dostaler, 2001; Mirowski & Plewhe, 2009). Hayek distinguishes himself in many ways from the economic mainstream (Dostaler, 2001; Caldwell, 2004; Mirowski, 2007; Boettke & O'Donnell, 2013), the neoclassical theory, which is represented when he writes by the general equilibrium program, even though it is not fully developed until 1954 and the work of Arrow and Debreu. But it is highly debatable to say that his work did not have a decisive influence on the productions and the theoretical mutations of the discipline. Thus, Robert Lucas explicitly represented himself as a continuator of Hayek (Laidler, 1982, p. ix), regarding the status given to the concept of information by Lucas.

Hayek develops in a systematic way a subjectivist epistemology based upon the statement of the division of information, which implies some major modifications for the understanding of concepts such as market, competition and prices, relatively to the conception which Hayek sees as hegemonic in economics, the general equilibrium analysis and its theory of pure and perfect competition (Hayek, 1948). This introduction by Hayek of the concept of information, especially in the text of 1944, that is to say, 'The Use of Knowledge in Society', will leave a mark on the whole discipline of economics, being one of the top 20 articles with the most citations of the *American Economic Review*.[5]

2.1. An economics of information

Hayek's theory is based upon a subjectivist position regarding information (Hayek, 1952, p. 31), correlative to his individualism that we can sum up in the following way: there are only individuals, and they are the only entity that can be said to possess information. This position is well developed in the articles of Individualism and Economic Order (1948) and in *The Counter-Revolution of Science* (1952). Hayek's subjectivism is more developed than the one we traditionally find in marginalism for the theory of value or in the Austrian perspective, for example in Menger position during the *Methodenstreit* or in Bohm-Bawerk's work on the interest rates. Indeed, Birner (2006) distinguishes between four connected meanings of subjectivism in Hayek's view: the facts of the social sciences are the opinions and desires of the agents (i), information is divided and heterogenous (ii), it is also limited and local, and thus human reason must concede to the wisdom incorporated in the social rules (iii) and the fact that the agents and the theorists can understand the actions of other people only because their minds work in the same manner (iv). All of these meanings stem from his position in theoretical

psychology. Hayek (1979, pp. 199–200) underlines the importance of his book *Sensory Order* for his philosophy of social sciences and his theory of information. In order to understand Hayek's views one as to start with this thesis, we will then see that his whole theory can be reconstructed from there (Birner, 2006; Butos, 1997).

How can we reconcile the fact that the information I possess is subjective with the subjective information of others, and thus how a world made of individuals following their own interest based on their local information can be in order? Some scholars consider that this thesis introduces a shift in Hayek's scientific production (Hutchison, 1981; Butos, 1985; Caldwell, 1984, 1988). If the main discovery of Adam Smith is the division of labor, illustrated with the example of the fabric of pin in the beginning of the *Wealth of Nations*, the great discovery of Hayek in economics is the division of information, that is to say, the fact that knowledge is shared among the different members of society and cannot be centralized by one particular entity or person. Economics is then just not the realm of material exchanges but of cognitive exchanges too. Hayek develops this theory in the context of the controversy on the scientific possibility of economic planning led by Mises with his book *Der Sozialismus* written in 1922 from an article of 1920, which constitutes the background of these theoretical analyses. Hayek defines his problem in the following way:

> The problem which we pretend to solve is how the spontaneous interaction of a number of people, each possessing only bits of knowledge, brings about a state of affairs in which prices correspond to costs, etc., and which could be brought about by deliberate direction only by somebody who possessed the combined knowledge of all those individuals. (Hayek, [1937] 1948, pp. 50–51)

Or, with another formulation by Hayek: how can the combination of fragments of information existing in different minds bring about results which, if they were to be brought about deliberately, would require a knowledge of all the information on the part of the directing mind which no single person can possess? (Hayek, [1937] 1948, p. 54). Information in this frame refers to the present and future information the individuals have or will have of prices, but also to the use that any individual can make of any good he possesses. This type of information is not only scientific knowledge but also all relevant information for the agents: how to use something, the quantities, and all the specific information given in a time and place. This information is then said non-homogenous because it cannot be reduced to one specific type, because individuals possess specific information, from their subjective history. This type of local and private information is for Hayek even more important than the scientific knowledge in order to understand the possibility of social coordination because most individuals rely primarily on this wider type of information for their actions. The definition of information is very large and can actually include almost everything, from the scientific knowledge available at a certain time to the very specific transformation of contexts and immediate circumstances.

Every individual possesses information, beliefs, and desires that are his own. The major consequence is that nobody can know it all, because information is for the main part subjective. The division of information is then a starting point in order to explain economic and political phenomena, and not an element to explain, an *explanans* and not an *explanandum*. Agents are thus cognitively limited, and this is why they follow social rules, or behavioral norms, that civilization created in order to promote cooperation. Here is a notable difference between Hayek and other economists: rationality is always socially bounded for Hayek.

The situation on the market is then for Hayek a situation of cognitive fragmentation: everyone possesses information but it is difficult to centralize all the information, especially in an intentional mechanism of regulation. The individuals do what they can in order to fulfill their goals, using information they possess. The original division of information introduces a clear rupture with the neoclassical model: the problem is not the one of general equilibrium, but to make the best of the available information. It is thus impossible for Hayek that a figure such as the auctioneer exists, equalizing the offer and demand functions.

We will, however, see that the focus upon the cognitive aspects of the coordination implies a new conception of the economic concepts of market and competition. We will follow Hayek's criticism of what he perceives as the standard view when he writes in the 1930s and the1940s.[6]

2.2. Hayek's conception of the market and competition

The market is the device of coordination in Hayek's theory. Hayek will in his later work, especially *Law, Legislation, and Liberty*, define this concept as a specific spontaneous order. The notion of order is not solely political but refers to all the situations of great complexity where it is impossible to assess the situation with universal laws (Hayek, 1955). The order exists in distinction with the organization, where the complexity – namely the fragmentation of information – is reducible enough to make planning possible, such as in a small business or a family. In comparison the order is the consequence of an irreducible complexity: nor the scientist neither the planner can produce a correct nomology of the situation. The definition of the market as an order ensues from the interactions of the individuals in a spontaneous, that is to say non-intentional, process. This process is the process of competition:

> Competition is thus, like experimentation in science, first and foremost a discovery procedure … Competition must be seen as a process in which people acquire and communicate knowledge; to treat it as if all this knowledge were available to any one person at the outset is to make nonsense of it. (Hayek, 1979, p. 68)

Competition is a procedure of research for individuals. The market is not the place where an offer and a demand encounter but a processor of information since prices works as signals for the agents, giving them objective information for their actions (Bourdeau, 2014). Hayek views competition and market in the general equilibrium theory as static. In this framework competition is a market structure where some conditions are fulfilled: atomicity, homogeneity, transparency, mobility of production factors and free access to the market. The individuals are price-takers and have the same information in virtue of transparency. Hayek may also have in mind the theory of Chamberlain, published in 1933, *The theory of monopolistic competition*, where the standards requirements for pure and perfect competition are not fulfilled. In this theory there are a lot of producers on the market but the products are heterogeneous, which implies some information asymmetry and a rupture with the atomicity condition. However, this distinction is not important in Hayek's perspective because it is still too static. What Hayek criticizes is less the specificity of the five requirements for competition than its core conception as not well suited in order to take the dynamic substance of the economic process. His conception of competition is different in kind.

The classical conception of competition, perfect competition, is thus replaced by a dynamic, a process of trade during which information is shared and spread. Perfect competition, where every individual has all the information available is described as a way to dodge the real question because of its static characteristics. Perfect competition indeed takes for principle what is the result of a competitive process:

> In other words, the description of competitive equilibrium does not even attempt to say that, if we find such and such conditions, such and such consequences will follow, but confines itself to defining conditions in which its conclusions are already implicitly contained and which may conceivably exist but of which it does not tell us how they can ever be brought about. (Hayek, [1946] 1948, p. 94)

Competition is then more of an epistemic process than a result. This epistemic dimension, in the sense that the agents in competition gather the information, changes the way we conceive competition itself. It is now seen as a process of rivalry and not anymore as a market structure. Competition is the general answer to the radical ignorance in which individuals are imprisoned. New information is discovered only because individuals are in competition. On this matter, Hayek underlines the entrepreneurial process of competition (Kirzner, 1988). The two meanings of competition clearly appear here: competition as market structure is a situation when the market can equalize the offer and

demand function; competition as rivalry in Hayek's work is not of the same kind, closer to the usual meaning of competition (Berthonnet, 2014). Thus, competition is defined as a tool in order to select good expectations or even rationality. Rationality is consequently not a hypothesis but the result of competition, which selects the most efficient expectations. This theoretical result is defended with an evolutionist approach in Hayek (1979), stating that competition results in the selection of rational behaviors and efficient rules, eliminating as a consequence the individuals that are less adapted (Hayek, 1979, p. 75). This dynamic assures for Hayek a better allocation of resources because the competition adapts to different situations: the price thus incorporates new information available and conveys them. This consequence is not totally unfamiliar for who knows the definition of efficiency proposed by Fama in his articles of 1965a (see section 2). The prices are therefore of central importance:

> The sum of information reflected or precipitated in the prices is wholly the product of competition, or at least of the openness of the market to anyone who has relevant information about some source of demand or supply for the good in question. Competition operates as a discovery procedure not only by giving anyone who has the opportunity to exploit special circumstances the possibility to do so profitably, but also by conveying to the other parties the information that there is some such opportunity. It is by this conveying of information in coded form that the competitive efforts of the market game secure the utilization of widely dispersed knowledge. (Hayek, 1979, p. 117)

Prices are a device of social coordination, incorporating the information of the entrepreneurial process in which individuals try to exploit 'special circumstances' and opportunities, answering to the problem Hayek asked from a subjectivist position. Hayek tends to restore the 'invisible hand' of the market *via* the price system, which incorporates new information during the perpetual process of competition and can then convey a form of objective information. In a social order, which we distinguished before from an organization, the prices become one of the only solutions for economic coordination.

Thereby Hayek answers his question: how can an order exist without anyone organizing it? The market, as a spontaneous order, is a central element of the answer. It can transform the subjective information of individuals in information objectivized by the prices. The dynamic aspect of the market, led by entrepreneurs who try to take advantage of opportunities is not ignored but this dynamic process is one of adaptation: the entrepreneurs show opportunities to the other who can imitate them and then stabilize the whole. This integration of the concept of information, that appears more and more often in Hayek's work, becomes preponderant in *Law, Legislation and Liberty* and transforms the concepts of market and competition. Competition is a process of discovery and learning.

If Hayek retains the idea of equilibrium from the walraso-paretian theory it is to explain the possibility of a tendency towards equilibrium (Caldwell, 1988; Arena, 1999). The pure market of the theory is criticized because it is highly tautological – two agents that know everything is in equilibrium only because we define equilibrium this way – and is begging the question of the discovery of the information itself. In his later work he abandons the notion of equilibrium for the one of order: the equilibrium supposes a static state where the information has been discovered already, while the conception of the competition and market of Hayek is highly dynamic (Hayek, 1964, p. 12). Hayek thereby transformed the concepts of competition and market to question about the possibility of coordination between the individuals that have subjective information. These transformations are epistemological, regarding not only the concepts that Hayek uses and his position towards the general equilibrium tradition but also his broader representation of the social world. We showed that this representation is determined by his conception of the division of information. This vision is encompassed in the fact that no one can beat the market because it incorporates all the relevant information. Hayek introduces consequently a fundamental symmetry between the observer, the planner, the scientist, the politician, and the observed, the acting individual. Because of his epistemological position, defining information as subjective and heterogeneous there is no possibility of disengaged central view. This acknowledgment laid the

foundations of the Hayekian world where only unintentional processes such as evolution (Hayek, 1976) or competition can lead us. The result is that prices incorporate all relevant information and are the mean of coordination.

Mirowski (2009) attributes a dominant version of the concept of the market to Hayek, who, according to him, transformed the ontology[7] of the concept:

> Perhaps the dominant version at MPS (Mont-Pélerin Society) emanated from Hayek himself, wherein 'the market' is posited to be an information processor more powerful than any human brain, but essentially patterned on brain/computation metaphors. (…). From this perspective, prices in an efficient market 'contain all relevant information' and therefore cannot be predicted by mere mortals. In this version, the market always surpasses the state's ability to process information, and this constitutes the kernel of the argument for the necessary failure of socialism. (Mirowski & Plewhe, 2009, p. 435)

Here we can observe that the conception of the market which is said to be dominant in the Mont-Pélerin Society is the Hayekian version of a market that contains all relevant information and thus is an information processor which is impossible to beat by a ruler or a mere mortal. This definition, and what it implies on the problem of social coordination, is what the authors called the first tenet of neoliberalism. We will see that this definition shares a lot with the definition of EMH. Can we then rightly speak of a common neoliberal world vision?

Before we compare Hayek's epistemology with EMH we have, however, considering the importance of the concepts of market and competition in our analysis, to refine two features of the market and competition that stem from the evolution of Hayek's views on the nature of subjective information.

2.3. Two features of the market and competition

Our analysis identified two core characteristics in Hayek's epistemology of the market: the market is an information conveyer, and it is an information creator.[8] The second characteristic is often overlooked, especially because it is explicated by Hayek after 'The Use of Knowledge in Society', which is his work that had more influence on economics. Indeed, if neoclassic economics broadly accepted the role of prices as information conveyer (Boettke & O'Donnell, 2013) the market has not been understood as a 'creative process' (Buchanan & Vanberg, 1991) in the mainstream literature. It is worth noting that if there is a difference between communicating and creating there is no contradiction: the market as a process discovers information possessed by the individuals and conveys it, and create, by the process of competition new opportunities and then new information during the process. The two features are two faces of a unique process if we understand that the interactions between individuals in market situations cause new interactions and then new opportunities for the individuals, that will act and then modify, through competition, the information to communicate. However, Hayek's thinking certainly evolved during the 1950', because of the influence of philosophy, especially Ryle, and of M. Polanyi (Oguz, 2010). This evolution encourages him to propose a philosophical conception of the socio-economic order as a whole. He underlined more and more not only the incapacity of the planner to centralize the information, as he did during the Socialist Calculation debate, but the tacit dimension of the information the individuals possess, that is to say the fact that most information the individuals have is in fact inarticulate. Hayek thus has a dispositional account of information as being incorporated. The specification about what kind of information is at stake in the market modifies the concepts of competition and market too: the market discovers things that could not be discovered without it, and competition is the condition of the emergence of new information. This is because the information possessed by the individuals is incomplete and subjective that we live under the realm of social rules. If, as Hayek put it earlier, the market is only communicating information that is pre-existing then planning is not logically impossible but only technically. Whereas if we recognize the creativity of the market process planning cannot even be

accomplished by an omnipotent and benevolent god because only competition can reveal the inarticulate information and create new opportunities through the process (Buchanan & Vanberg, 1991). The market reveals indeed the inadequacy of individual dispositions and forces them to adjust their preferences (Boettke & O'Donnell, 2013, p. 313). Can we identify these two features in the conception of the market in the work of EMH theorists?

3. When the efficient market hypothesis meets Hayek.

A market is informational efficient if all information available about assets prices are integrated into current assets prices, which is indeed a formulation close to the one we find in Hayek. The EMH represents a keystone of financial economics in many aspects. From a historical perspective, the information efficiency has been one the key research program in the constitution of modern financial economics in the 1960s (Jovanovic, 2008). It still represents today the central framework in financial economics to describe the financial markets (Vuillemey, 2013). Many subfields in financial economics have been dedicated to developing the implication of this hypothesis, and many other central contributions to financial economics claim a direct link with the EMH. It should be noted that the EMH is not only a theory of information among others that we decided to compare to Hayek. Our focus on EMH is also motivated by its importance on the historical constitution and his analytical centrality in the financial field.

Conversely to Hayek's theory, the EMH has been developed by a set of heterogeneous researchers. The comparison with Hayek's theory requires then to avoid these heterogeneities to focus on the key ideas behind the informational efficiency. We choose to present the contributions of Holbrook Working and Eugene Fama. Our focus on Eugene Fama is obvious since his contributions are considered as the more systematic exposure of informational efficiency. Holbrook Working, however, is known only by the specialists of the field as a pre-theoretician of EMH who introduces the issue of information in speculative markets (Berdell & Choi, 2018). However, Working exposes with more clarity the problematic that lays behind efficiency. We begin our account by presenting these intuitions. It consists mainly in introducing the role of expectations and the role of dispersal information in the determination of assets prices which are going to be commonplace in financial literature. We then display the more theoretical and formal formulation of EMH given by Fama which becomes the standard view in the literature.

3.1. Holbrook working: information and forecasting.

The issue about the use of information in finance has been discussed openly by the first Anglo-Saxon researches on finance in the 1930s. The studies of Alfred Cowles questioning the forecasting skills of forecasters are an illustrative example (Cowles, 1933, 1944; Cowles & Jones, 1937). Cowles shows that forecasts' forecasters were not better than a random strategy. Based on Cowles' studies, economists believe in the objective prediction of economic science, whereas traders were attacked for the unscientific character of their forecast (Dimand, 2009; Dimand & Veloce, 2010). The question is then similar to Hayek's problem, in other words, the question of the centralization of information. In 1934, Working publishes a well-known article in which he notices the random character of assets prices changes (Working, 1934). The informational issue rises naturally from this finding. Like Cowles, it questions the forecast of traders and thereby the information used by traders to forecast. Working puts in the same line the issue about the information possessed by traders and the knowledge of economic theory. If random fluctuations question the forecasters' forecasting, why should it not question the economic science too? In the 1930s, even he does not have yet a systematic view on the issue, Working already defends the accuracy of practical men's information about forecasting, for instance, in this wheat prices study, he suggests that businessmen have likely a more accurate view about wheat market tendencies than any economic theorists:

> Ask a number of intelligent businessmen of long experience with wheat prices to state the tendencies they believe to exist, and you will get much more general agreement with the propositions here stated that will be obtained from economic theorists. (Working, 1935, p. 425)

In this quote, Working suggests that the subjective information possessed by experienced businessmen may have more accuracy than the objective knowledge produced by current economic theory.[9] Still in the 1930s, and while the mainstream research viewed speculators as ill-informed agents[10], Working suggests the importance of trader's information on price formation: 'prices … are not so haphazard and imperfect as one may judge from too restricted a view of the information and trading habits of individual speculators' (Working, 1937, p. 310).

Working (1949) follows and reinforces the same trend by acknowledging that 'perhaps the absence of recognized scientific significance of 'traders' information reflects inadequacy of our perception rather than absence of real significance' (Working, 1949, p. 150). In short, maybe traders' expectations make sense: it reflects the incapacity of economic theory to understand the expectations of traders and the information they use, namely not only scientific information but local and contingent information. Working suggests then that Cowles' finding should be reinterpreted:

> Some years ago, Alfred Cowles made a critical study of the economic expectations recorded by professional stock-market forecasters. The main conclusion which emerged was that these expectations had characteristics substantially identical with those of random guesses. We shall see before we finish that such an observation is not necessarily evidence of poor forecasting. (Working, 1949, pp. 151–152)

In order to show that, he makes a logical distinction between two kinds of expectations errors. First of all, errors can result from unpredictable factors, independent from the agents, what Working calls 'necessary errors'. It results then that the second kind of errors which may occur results from predictable factors, dependent on the agents, what Working calls 'objectionable errors'. In an 'ideal market' (Working, 1949, p. 160), expectations should be subject only to necessary errors, errors that result from unpredictable events. Assets prices fluctuations of such a market will be entirely unpredictable:

> Ideal market expectations would have taken full account of the information which permitted successful prediction of the price chance. […] An interesting consequence of this proposition is that, given an ideal futures market in which market expectations exhibited only necessary error, it would be impossible for any professional forecaster to predict price changes successfully. (Working, 1949, p. 160)

Working then links this finding to his own observations about the random character of financial fluctuations: 'Changes which are completely unpredictable are, by definition, random changes' (Working, 1949, p. 160).

The crucial point we want to stress here is that Working's contribution is not only theoretical, but it is also mainly a transformation of the relationship between the observer and the observed on the information possessed. From an overhanging position, the observer symmetrizes his cognitive capacity with the observed. Beyond the construction of a theory of expectations, he highlights the significance of the subjective character of information of investors by suggesting that traders' expectations should be taken more seriously than it was: 'Apparent imperfection of professional forecasting, therefore, may be evidence of perfection of the market. The failures of stock market forecasters, to which we referred earlier, reflect credit on the market' (Working, 1949, p. 160). In this respect, whereas the researchers of his time were looking for an *objective* model of forecasting, Working reverses the logic by modeling the *subjective* foreseeing of agents. It leads then to focus, not anymore on what kinds of information are relevant, but on how agents use information inaccessible to the theoretician: '*Anticipating events requires special information and special skills.* While some traders seek to predict crop developments, others seek to predict changes in general business prospects' (Working, 1949, p. 194, we emphasize). If Working gives an example of what relevant information is, he does not aim at defining objectively the content of information. Like in Hayek's theory, information is what is useful for agents' decisions, that is here, the price changes predictions.

Moreover, noting that 'the amount of pertinent information potentially available to traders in the most modern market is far beyond what anyone trader can both acquire and use to good effect' (Working, 1958, p. 158), Working gives the intuition of the – Hayekian like – division of information:

> Circumstance and inclination lead different traders to seek out and use different sorts of available information; and if at any time some sort of available and useful information is being generally neglected, someone is likely soon to discover that that neglect offers him a profitable field to exploit. In short, traders are forced and induced to engage in a sort of *informal division of labor in their use of available information*. (Working, 1958, p. 158, we emphasize)

It is particularly interesting that we find in Hayek's writing the same defense of traders' subjective knowledge (Hayek, 1948, pp. 80–81).[11] Working uses the same argument as Hayek, who underlined the entrepreneurial process of the market. Both arguments share the same structure and the same emphasis on the necessity of local information but also the same figure in order to make the market process work, that is to say, one of the entrepreneur/traders. Working does not only develop a representation of informational market, he has also a conception of information as subjective information, that is, local knowledge of traders. We thus find in Working's writing the two features of the market and competition that we identified in our analysis of Hayek's epistemology. The market prices reflect available information and competition is a process of discovery through the actions and expectations of the individuals. However, Working does not develop explicitly the modern notion of efficiency even if, retrospectively, he has developed its main intuitions (Berdell & Choi, 2018; Jovanovic, 2008).[12] The EMH will be developed in the 1960s during the emergence of the financial economics field. We focus now on the work of Eugene Fama, which has developed the most famous formulation of EMH.

3.2. Fama and the efficient market hypothesis

Fama introduces the concept of 'efficient market' in 1965 (Fama, 1965a, 1965b). In the 1960s, the issues of Cowles, Working, and others on the unpredictability of prices changes become the main research program of the emerging financial economics (Jovanovic, 2008; Walter, 2013). Regarding the multiplication of empirical studies showing the nearly random character of price changes, the scholars raise doubts on the possibility of a strategy of investment able to beat systematically the market. The problem of division of information stressed out by Hayek was raised identically by early financial economists but in different context: is there an agent or a group of agents able to centralize information better than the market (here in order to make forecasting)? Fama answers with a clear no to this question by formulating, and corroborating empirically, the notion of 'efficient market'. In his definition, Fama draws the representation of an informational competitive market:

> In an efficient market, competition among the many intelligent participants leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based both on events that have already occurred and on events which, as of now, the market expects to take place in the future. In other words, in an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value. (Fama, 1965a, p. 76)

This first definition describes a financial market where the competition leads, first of all, to the integration of all information in the prices of the assets, and, secondly, to the equalization of assets prices to the intrinsic value. Although Fama considers the two aspects as synonym, he will give up this second aspect in his following writings to focus on the first part of the definition. Similarly, to Hayek and Working, Fama does not characterize the notion of information by its content, it is a definition based on what is useful for making price changes expectations.

What appears already in this first definition is a particular conception of competition: it is a process which leads a set of subjective information to be centralized objectively in a system of prices. The market appears as a processor of information (Mirowski & Nik-Khah, 2017), and prices as the result of this competition process. This conception of market prices is particularly

apparent in his review of empirical literature (1970). After he defines an efficient market as a market in which 'prices always "fully reflect" available information' (Fama, 1970, p. 383), Fama distinguishes his famous three tests of EMH: weak, semi-strong, and strong. The weak form tests if the market prices integrate all past information, the semi-strong form adds the current public information, and finally the strong form tests also the current private information (Fama, 1970, p. 388). Beyond this classification of empirical tests, it appears as a classification of the capacity of the market to fill its role given by Fama, that is, to integrate information in asset prices. The similarity between Hayek and the EMH is then multi-dimensional. Written in the same period, answering to the same issue about centralized information, the two theories defend a new representation of the market as an informational processor.

Can we end the comparison so easily? There are strong differences between the efficiency of Fama and the efficiency[13] of Hayek's theory of prices. Until now, we passed over many analytical differences between the two approaches. The formulation of EMH by Fama (1976a; 1976b) will illustrate this issue. In Fama (1976b), a market is efficient if and only if:

$$f(P_t|\theta_{t-1}) = f_m(P_t|\theta^m_{t-1}),$$

where P_t is the vector of the price at time t, θ_{t-1} the set of information available at time $t-1$, θ^m_{t-1} is the set of information used by the market, $f(P_t|\theta_{t-1})$ is the true density function implied by θ_{t-1}, $f_m(P_t|\theta^m_{t-1})$ is the market assessed density function for θ^m_{t-1} (see Fama, 1976b, p. 143).

This formulation means that a market is efficient when the aggregate subjective information of individuals $f_m(P_t|\theta^m_{t-1})$ equals to the *a priori* objective information $f(P_t|\theta_{t-1})$. In short, a market is efficient if the market expects rationally the prices (see, Delcey & Sergi, 2019 on the relation between EMH and rational expectations). Fama specifies that by saying 'the market' does something is just a 'convenient way of summarizing the decisions of individual investors and the way these decisions interact to determine prices' (Fama, 1976a, p. 135). This formulation avoids entirely the heterogeneity between individuals and then the role of subjective and local information, a fundamental aspect of the Hayekian theory we highlighted in the first part. Secondly the rationality that Fama refers to is absolutely unfamiliar with the conceptions of Hayek. Indeed, Fama (1976a, 1976b) uses the word in relation to the rational expectations, while the expectations of Hayek cannot be said rational (Butos, 1997). Moreover, Fama talks about market which 'assesses probability distributions' implied by $f_m(P_t|\theta^m_{t-1})$ he supposes two implicit assumptions:

> this can only be a completely accurate view of the world if all the individual participants in the market (a) have the same information and (b) agree on its implications for the joint distribution of future prices. (Fama, 1976a, p. 167)

Beyond the central aspect given to information by each approach, the assumed cognitive abilities of individuals are however fundamentally different. Fama assumes that information is the same for everyone. It leads him to fall under one of the main critics Hayek made to general equilibrium, that is, to dodge, by assuming a homogeneity, the real question of how a market composed by different individuals is ordered. Can we then identify clearly the lineage between the two theories? The next section of our paper discusses this issue.

4. The problem of comparisons

We will at first clarify the difficulties that we encounter when we want to propose a systematic comparison between Hayek, Fama, and Working. Indeed, we showed that these authors shared similar conceptions on information, markets, and competition. But a cautious reading of the texts of these different authors also shows very different orientations and propositions. The thesis of a lineage between Hayek and EMH needs thus a more systematic demonstration**.** We will justify our interpretation with a distinction between methodology and epistemology, insisting on the fact that most differences lay in the realm of methodology.

4.1. Hayek and mainstream economics

We do not propose to go as far as David Laidler (1982) went with Lucas, Sargent and other economists of the new classical economics and say that Fama and Working are Hayekians. Indeed, Hayek has been compared already with a lot of economists, and one must not confuse comparison with identification. Furthermore, neither Working nor Fama referred to Hayek as an inspiration to their work explicitly.[14] First of all, the context in which Hayek writes is very different from the context that gives rise to financial economics and efficiency. Hayek reacts to historical and political problems, such as the World War, the rise of totalitarianism and, last but not least, the problem of economic planning. In order to understand his work, one has to investigate the crisis of the twentieth century. He is not strictly speaking an economist after the Second World War, but belongs to social sciences departments and focus on much larger problems of political philosophy, eager to spread a revigorated liberalism with the Mont-Pélerin Society (Mirowski & Plewhe, 2009; Audier, 2012; Burgin, 2012). Working and Fama did not join the Mont-Pélerin Society. If Fama expressed openly his libertarianism in a few occasions, he remained particularly reserved on political and ideological public issues (Nik-Khah, 2011, p. 376, Klein, 2018). They are concerned by scientific issues, mainly, finding explanations of prices fluctuations in speculative markets and testing them empirically. From that perspective, the closeness of EMH with the formal language of economics, mainly the general equilibrium and econometrics methods, has played a key role in the emergence and the legitimation of financial economics as a subfield of economics (Jovanovic, 2008; Fourcade & Khurana, 2013, 2017; Brisset 2018). It is assured consequently that Hayek and EMH theorists do not share the same representation of the agents, Hayek being more interested in a general description of human action, while Working and Fama follow the modeling trends after the Second World War.

Consequently, and secondly, the scope of Hayek's theory is much broader than the scope of Working or Fama's work: Hayek is interested in philosophical problems of social coordination, to elaborate a theory of social norms and their evolution, and to develop a theory of human conduct, many problems that do not appear in the work of EMH theorists. There are some differences in terms of problematic: the 'Hayek problem' (Zijp, 1990) is the very general one of inter-individual coordination, while the problems that give rise to the financial economics are related to the more specific issue about the performances of the investors.

Finally, on many important issues, Hayek and EMH theorists distinguish themselves considerably. The assumptions on the individuals are clearly unalike. For instance, Audier (2013) argued that the representation of the individuals in Hayek and in the Chicago School are radically different, the first developing a theory of rule-following, the second holding on *homoeconomicus*. The same can be said for the concept of expectations that Hayek, Working and Fama use. For Hayek the expectations are not rational, as Butos (1997) showed with a precise reading of Hayek's book *Sensory order*, but local, related to the limited information the agents possess and consequently heterogenous, closer to a tacit disposition than an intentional view while in Fama's work the expectations are homogenous and explicit. Consequently, some scholars, for example Boettke and O'Donnell (2013) expressed that the Hayek' position is, because of its insistence on subjective and dynamic processes, doomed to be misunderstood by formalist economists.

Nevertheless, one may acknowledge the historical convergence between Hayek and Chicago, where Fama completed his Ph.D. with Merton Miller at the Graduate School of Business of Chicago in the early 1960s. Recent works (Van Horn, 2009, 2015; Van Horn and Mirowski, 2009) have shown in particular that Hayek had a profound influence on economists such as Stigler (1961) and Friedman (1962)[15] who, in turn, have participated to the emergence of the Graduate School of Business, led at the time by their friend, and members of the MPS, Warren Wallis (see Van Horn, Mirowski, & Stapleford, 2011; Fourcade & Khurana, 2017). If the methodology of Chicago economics and thus of Fama differs from Hayek's methodology, it is difficult however to refute that Hayek's ideas have not infused the imagination of Chicago theorists, including financial economists.

Still, as reminded by Caldwell (2011) the fact that Hayek plays a key role in the foundation of the Chicago School does not itself shed light on the general issue of neoliberalism. Is the lineage between Hayek and EMH leading to an understanding of neoliberalism as a common conception of the role of the market condemned to be an oversimplification?

4.2. Methodology and epistemology: survey and definitions

We characterized the similarities and the differences highlighted as respectively epistemological and methodological. Epistemology and methodology are broad terms variously defined in the philosophy of science literature.[16] The term epistemology here is not related to the theory of science the authors defend but to the core concepts or their theories.[17] Methodology is then defined as the way the authors operationalized their epistemology, as we defined, in the field of scientific production. The history of financial economics encounters the same problem of the division of information than Hayek and develops the same answers: subjectivism for the information, the symmetry between the observed and the observer with the impossibility to centralize information, which gives birth to the same modification, beyond methodological differences, in the concept of market and competition. We called this epistemology in order to underline the fact that the authors share the same vision of information possessed by the agents. Information becomes the core concept for interindividual coordination, that is allowed by the operations of the market. Indeed, individuals in the market convey and create information, the competition allows efficiency and the agents react accordingly to the prices. We ought then to distinguish between epistemology, relative to the fact that both theories have a common representation of information possessed by agents, and methodology, relative to the scientific way the authors realize these theses.

That being said methodological differences can be really important and decisive differences and give birth to radically different theories. Hacking (1983) shows for example that the bottom-up approach founded upon the practices of the day-to-day scientist was crucial in order to understand the long-run diversification of theories. Our thesis is that the differences between Hayek and the corpus we studied in the theory of efficiency, especially Fama, are mostly methodological. For example, the use of rational expectations by Fama, that contrast with Hayek's vision of the individuals, is explicitly for Fama a mean to study in the static the market itself with simple assumptions. Thus, the differences in terms of methodology are highlighted by a common background, which is composed of common epistemological problems. As Hacking (1983, p. 5) shows with Popper and Carnap the differences appear sometimes greater than they are when there is a common ground upon which they become commensurable.

4.3. Formalization as a methodological difference

We already showcased some differences in the context of the two corpus writings and on the scope of the two respective approaches. These differences are crucial since they imply significant analytical differences. Hayek is reacting directly to the political philosophy behind the general equilibrium problem, his answer shares the same level of generality: a description of the economic system that he tries to spread outside the scientific field. Embodied in the rise of early econometrics, Working and Fama stress out the necessity to test empirically a rigorous model. From his first articles on EMH (1965a, 1965b), Fama's model becomes formal (1970, 1976a, 1976b). The information becomes a given mathematical set, and the representations of agents about the future become the same given law of distribution for everyone. Thus, radical ignorance is replaced with a probability law. The fundamental dynamic aspect of Hayek implied by the crucial heterogeneity between agents and radical ignorance disappears.

In the same vein, Fama's efficiency (1965a, p. 76) assumes that information is 'almost freely available' what has been seen as contradictory with the Hayek's theory in which costly information is central. If the information is freely available and reflected in prices, the incentives for a competition

on information disappear (see Grossman & Stiglitz, 1976, pp. 404–405).[18] Hayek indeed, as soon as 1935, in an article on the socialist calculation debate called 'Socialist Calculation: The Nature and History of the Problem', noticed that what made planning impossible was the fact that information was not free but costly at an individual level. This is because the information is costly that the market possesses asymmetries of information.

In Fama (1970), efficiency of the market is thought as a static feature of market in which 'prices always "fully reflect" available information', while Hayek insists on the dynamic and never-ending process of discovery of information which 'be completely missed by any theory which treats these data as constant' (Hayek, [1946] 1948, p. 106).

Are those differences decisive? Fama (1976a, 1976b) adopts a formal formulation which contrasts *de facto* with Hayek's one. In particular, by assuming a probability law for the 'market' common to every market participant, Fama ignores the role of local and subjective information. However, Fama does not defend his model as describing ontological features of the world. On the contrary, when Fama discusses the realism of his model he tends to approach Hayek's theory by arguing that he has in mind individuals with heterogeneous opinions:

> Strictly speaking, this implies that investors have monolithic opinions about available information and act single-mindedly to ensure that their assessments are properly reflected in current prices. *What we really have in mind, however, is a market where there is indeed disagreement among traders but where the force of common judgments is sufficient to produce an orderly adjustment of prices to new information.* (Fama, 1976a, p. 168, we emphasize)

What Fama does have in mind is a dynamic process with heterogeneous agents, in which efficiency of the market is produced through the interactions of the individuals. Indeed, prices are the result of 'common judgments' produced by the process of competition, that is the agreement among individuals upon the value of an asset. In this perspective the price is the end of a process of opinion formation as Hayek stresses out (Hayek, [1946] 1948, p. 106).[19] Fama investigates the testability of an informational efficient market, the finality of the dynamic processes described by Hayek. In order to do so he has to use methodological devices for the formalization. The differences in terms of scope then imply a difference in terms of methodologies: Fama wants to test his model in the mainstream and formal framework emerging after the Second World War. When Fama explains the purpose of his model he moves towards a more Hayekian position because his model describes the state of the market resulting from a Hayekian competition process.

5. A common core

5.1. The same epistemology: information and symmetry

The view of the market as informational processors can be seen as the keystone of Hayek's theory and the EMH: the two theoretical approaches start from the understanding of the difficulty to centralize information (by governmental or financial professional entities). This difficulty leads Hayek as well as Working and Fama to stress the role of local and subjective information, which cannot be fully taken into account. We already saw that both Hayek and Working, before any theoretical analysis, try *first of all* to reevaluate the subjective information of specialized agents, intrinsically personal and therefore, intangible for economic sciences.

The notion of information appears as the objective description of this unattainable knowledge, that is, an objective description of an unopened black box. In Hayek and EMH theories, there are not attempts to describe with precision the content of the information used by agents.[20] The notion of information is only described by its finality: agents use the information they need to achieve an economic action. They had the correct information if this action is actually achieved. The theory does not and cannot discuss the content of the local and subjective information used by agents since it is defined as impossible to centralize by a theoretician.

Another way to stress this epistemological similarity is the introduction by both approaches of symmetry[21] between the observer and the observed. This symmetry is implied both in the work of

Hayek and in the works of Fama and Working, as a consequence of their position on the information. Hayek introduces symmetry between the observer and the observed, because of the impossibility to centralize all the information, as we showed above. The impossibility to centralize deprives the scientist, or the policymaker, of his prominent situation. We have seen that the problem gives rise to the questioning, by Working, of the scientific knowledge. In an informationally efficient market, information is integrated into the prices, which makes the prediction impossible for an individual, even for the most talented scientist.

5.2. Market and competition

By stressing and systemizing the issue of information, both theories offer a new conception of what is the market and what role it fulfills. The market described by both theories fills a new role: to centralize this subjective information in a price system and to discover new information through the process of competition. The market usual main role is to coordinate the supply and the demand, it is from now on to coordinate the agents in their research of information. The shift is noticeable: the question is not only one of the allocation of resources but of cognitive coordination. Hayek explicitly formulates this:

> The mere fact that there is one price for any commodity – or rather that local prices are connected in a manner determined by the cost of transport, etc. – brings about the solution which (it is just conceptually possible) might have been arrived at by one single mind possessing all the information which is in fact dispersed among all the people involved in the process. (Hayek, 1948 [1945], p.86)

Hayek described this as a 'marvel' (Hayek, 1948 [1945], p. 87): the functioning of the market, with prices coordinating the individuals and their actions, takes the role of the central institution of our society. Hayek's conception of the market has been linked explicitly to EMH by Grossman and Stiglitz (1976, p. 249): 'Still a third important and related observation is that prices, in our model, are serving two functions: not only are they being used to clear markets in a conventional way, but they convey information.'

In the same vein, the role of the competition changes. Competition appears as an impersonal mechanism that selects and discovers relevant information, or more specifically, selects the relevant economic action using relevantly the current information. Competition is, therefore, a dynamic process, a process that leads information to be discovered, shared, and spread. In this perspective we shall not underestimate the importance of the entrepreneurial action of the individual, highlighted by Hayek as well as by Working. Their role is to use unseen opportunities and then discover new information. Thus, we see here that EMH adopts the first feature of the market as information conveyer, but also the second feature of the market as a creative process.

Of course, the former consideration does not mean that this role of competition has been invented fully by Hayek or EMH. In the history of EMH for instance, it is particularly usual for instance to find these intuitions in many others and preliminary works, of the period or even before.[22] However, EMH and Hayek's theory appear as a systemizing analysis of this market conception. It does not mean that the idea that the market coordinates the supply and demand disappears entirely from these frameworks. It is easy to separate agent seeking information between suppliers and demanders, but these concepts become a minor aspect relative to the main problem of the coordination of scattered information.[23]

5.3. Informational efficiency in Hayekian theory?

Because the authors share common ground on the division of information throughout society and a similar definition of information, we can formulate a theory of efficiency in Hayek's work. As we have seen the first formulation of Fama (1965a) efficiency as the fact that prices reflect all available information. This intuition is developed by Hayek in 1945, especially in 'The Use of Knowledge in Society', as many authors noticed (Vivès, 2008). Hayek takes the example of evolution in a market, a new opportunity, the disappearance of a source of supply. All the individuals do not have to know

everything (what caused the disappearance of the source of supply), indeed if just some people know the cause of the change the information will spread because they will turn their investments to substitutes and then modify the price of the good, which thus reflects the new situation of the market (Hayek, 1948 [1945], pp. 85–86). The prices in Hayek's terms allow the formulation of a criterion of efficiency: we don't have to know everything since the prices reflect the information and are enough to take our decisions. Economics of information has for consequence an economy of information. The theory of Hayek states that prices will reflect all the available information in a free market, assuming that there is no rigidity that would make it work less efficiently.[24]

The most extreme version of EMH assumes that prices reflect fully all available information while Hayek defends a weaker version, we may call it a conception of the market as powerful since the market is said to integrate information better than any individual or institution separately.

6. Concluding remarks

The first result of this paper is to deny the claim that EMH is Hayekian and conversely. The methods, the contexts, and the scopes are too different, beyond the fact that neither Working nor Fama explicitly refers to Hayek as a source of theoretical inspiration. However, stressing fundamental differences between both approaches does not imply that there are perfectly orthogonal. Considering the many aspects of their analytical proximity; the problem of centralized information, the importance of subjective and local information that leads to the representation of a market as an informational processor.

A common epistemology thus remains, which seeks to describe a market in which subjective information of individuals is ordered in an objective system of price. Individuals are thought of as entrepreneurs with special information. We can then find the same conception of market and competition, as information conveyer and information creator, in both theories. In a nutshell we can identify four tenets: individuals have dispersed information; market can coordinate the individual plans through competition; the market is efficient. In this perspective most of the differences are the consequence of a difference of perspective: Fama studies the end of the process that Hayek describes.

We used in order to encapsulate this idea the concept of epistemology. The similarity is labeled as epistemological in distinction with methodology. The literature underlying the differences between Hayek and other thinkers is acknowledged but, because of its main focus on methodological aspects, not considerate relevant on the epistemological level that is our main concern. These results underline the importance of the mutation introduced by Hayek in economics, as proposed by authors such as Mirowski (2007, 2009) or Cahill and Konings (2017) for example.

The epistemological similarity we stress raises also historical issues. If we aim at comparing analytically two sets of *a priori* independent corpuses, it is clear that the proximity between the two approaches questions the potential inter-influence between the authors. If the influence of Hayek has been investigated, it remains a mystery how the concept of information appears so spontaneously and becomes central in financial economics. Even if any direct link can be built between Hayek's theory and EMH, it raises a more important issue about how these two apparently independent theoretical innovations, written nearly at the same period, share so much. In other words, they are maybe two different ends of a same set of causes, and therefore, they are just reflecting a more general and deeper change at this period. This brings us back to the question of the possible *Weltanschauung* shared by the authors of the period, that some scholars labelled neoliberalism (Mirowski & Plewhe, 2009; Burgin, 2012; Cahill & Konings, 2017).

Notes

1. The term if highly controversial in the scholarship. However, we do not intend to use if negatively here, contrary to the major tendency in the late publications (see Boas & Ganz-Morse, 2009), but above all descriptively.

2. It is difficult to reduce the Efficient Market Hypothesis to only few names given the number of contributions to this research program (Jovanovic, 2008). The introduction of Section 3 justifies our choice to select Fama and Working's works.
3. We use these distinctions between schools following other scholars, such as Caré (2016), that provided a typology of schools in economics.
4. On this issue, see the history of random walk in finance by Jovanovic (2009) and Walter (2013).
5. We will use the terms knowledge and information as synonyms here, following Hayek himself and the habit taken by translators to translate knowledge by information (Mirowski & Nik-Khah, 2017, p. 66). For more details about Hayek's use of information and knowledge and the distinction that one can draw between the two concepts see Elias (2002) and Boettke and O'Donnell (2013).
6. The main point here is not to characterize precisely the general equilibrium program (see Weintraub, 1983, 1985; Cot & Lallement, 2006).
7. The term 'ontology' appears in Mirowski's article. However, we will not focus on the ontological dimension of the shift.
8. In our formulation 'the market' is the subject but one may remember that the market is the unintentional consequence of the intentional actions of the individuals, thus it does not exist or act in its own rights. The market is not an individual. In Hayek's individualism we can always describe the institution of the market as the result of choices made by individuals in a competitive environment. When we use the expression 'the market' we always have to keep in mind that is does not make anything, but that the market is our linguistic term for naming the consequences of the intentional actions of the individuals.
9. Here the knowledge produced by the theory is similar to the 'scientific knowledge' we discussed in the previous section.
10. See Berdell and Choi (2018) for a recent account of Holbrook Working's view on information in the 1930s, in particular, his contrasted view with the Grain Future Administration on speculation.
11. 'or the arbitrageur who gains from local differences of commodity prices, are all performing eminently useful functions based on special knowledge of circumstances of the fleeting moment not know to others. It is a curious fact that this sort of knowledge should today be generally regarded with a kind of contempt, *and that anyone who by such knowledge gains an advantage over somebody better equipped with theoretical or technical knowledge is thought to have acted almost disreputably*' (Hayek, 1948, pp. 80–81, we emphasize).
12. Lately, Working has been in contact with important contributors of EMH such as Paul Samuelson (see Delcey, 2019).
13. Our use of the term efficiency here for Hayek is anachronic and partly incorrect: Hayek never formulated a theory of EMH. We use the same term here in order to facilitate the comparison. See section 5 for a theory of efficiency for Hayek.
14. If we except the fact that Fama describes himself in an interview in the New York Times in 2013, October 26, as 'an extreme libertarian' and as a reader of Hayek's *Road to Serfdom*. Some chronological conjectures can be proposed in order to link Hayek with Working too, notably the fact that the 1949 and 1958 articles of Working, written after the 1944 article of Hayek which had a lot of success, seem to borrow some conceptions to Hayek's theory.
15. Stigler and Friedman, both members of the Mont-Pèlerin Society, quote Hayek in their respective works, and pay specific attention to the 'epistemic turn' (Boettke, 2018, p. 232) impulsed by Hayek in economics.
16. Many writings of famous methodologists or philosophers of economics define methodology in a various way. See McCloskey (1986), Rosenberg (1992, p. 10) or Blaug (1992, p. xii) for various definitions. Epistemology usually refers to the philosophy of science, and especially to the criterion that are used by authors such as Popper, Kuhn, Lakatos or Feyerabend, for example in order to distinguish science and pseudo-science.
17. We borrow this mode of thinking to Lakatos (1970). Nevertheless, we do not use this distinction as a normative distinction in order to assess programs of research.
18. Fama acknowledges, after Grossman and Stiglitz's article, that information should be costly (see Fama, 1991, p. 1975).
19. 'Competition is essentially a process of the formation of opinion (…). It creates the views people have about what is best and cheapest, and it is because of it that people know at least as much about possibilities and opportunities as they in fact do'(Hayek, [1946] 1948, p. 106).
20. Hayek provides only some examples on this subject, especially in his texts of the debate on the possibility of economic calculation under socialism. For example, Hayek (1948 [1935], p. 154):

    > The information which the central planning authority would need would also have to include a complete description of all the relevant technical properties of every one of these goods, including costs of movement to any other place where it might possibly be used with greater advantage, cost of eventual repair or changes, etc.

    Fama also provides some examples, that is to say any information related to the earnings of the company 'which in turn are related to economic and political factors' (Fama, 1965a, p. 36).
21. Sent (1998) justly showed, on her work on Sargent, that symmetry was the consequence of a specific conception of information, not possessed solely by the expert, the government or the observer but also by the agents.

22. See for instance the discussion of the Kendall (1953). See also (Walter, 1996; Jovanovic, 2008) for the early contributions which formulates intuitively the informal efficiency.
23. Working (1958) has a hybrid status and mixes his analysis of information with the classic concepts of supply and demand.
24. The term 'efficient' appears in Hayek's work, in order to say that the free market is more efficient than the socialist society. The price system is then defined as 'efficient' by Hayek in the same passage, see Hayek, (1948 [1945], p.87).

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Notes on contributors

Nathanaël Colin-Jaeger is a Ph.D. candidate in Philosophy at the Ecole Normal Supérieur of Lyon and Triangle. His work focuses on the development of the neoliberal thought from Hayek to Law and Economics.

Thomas Delcey is a Ph.D. candidate in Economics at University Paris 1 Panthéon-Sorbonne and Centre d'Economie de la Sorbonne. He is working on the emergence of financial economics and the history of the concept of information in finance.

ORCID

Thomas Delcey http://orcid.org/0000-0003-0546-1474

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