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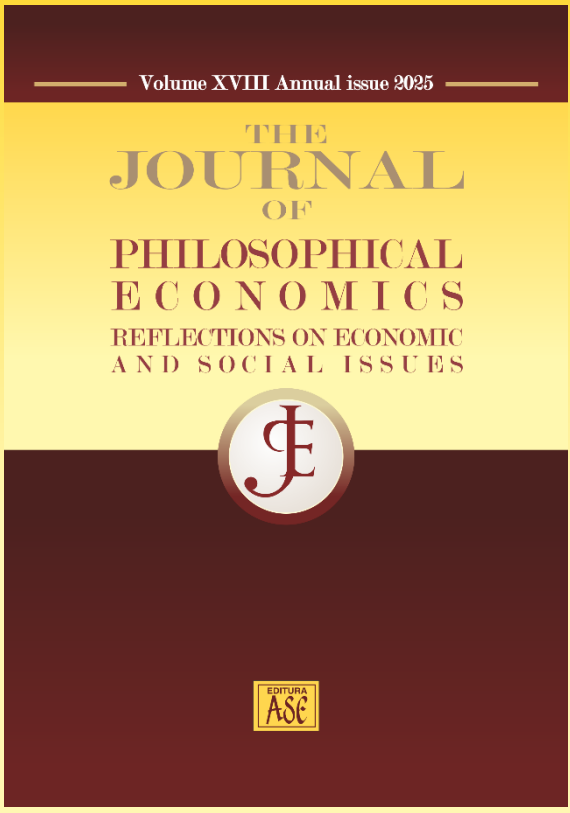


# Infinitely elastic? The influence of the Efficient Markets paradigm on financial regulation

Mathias Skrutkowski

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# Infinitely elastic? The influence of the Efficient Markets paradigm on financial regulation

*Mathias Skrutkowski*

**Abstract:** This paper examines the influence of the Efficient Markets Hypothesis (EMH) on financial regulation, using a perspective drawing on arguments from the Philosophy of Science discipline. The paper aims to show that, prior to the global financial crisis, there already existed a large body of empirically observed asset price anomalies, which may be seen to contradict the notion of elastic demand curves. However, proponents of the EMH tended to interpret these as corroborations, rather than refutations, through articulation of what Kuhn would characterise as ad hoc hypotheses. The Information Hypothesis is identified as particularly influential in this respect. Furthermore, the paper makes the argument that, when supplemented with the Information Hypothesis, the hypothesis of elastic demand curves becomes tautological and thus unfalsifiable, violating Popper's standard for scientific theories.

**Keywords:** demand elasticity, philosophy of science, scientific paradigms, ad hoc hypotheses

## Introduction

For many years, textbook financial theory would suggest that demand curves for financial assets are infinitely elastic (nearly horizontal), since the price at any point in time reflects all information available about the asset, as proposed by the Efficient Markets Hypothesis (EMH). Thus, traders should be able to buy and sell blocks of an asset of unlimited size at the prevailing market price, without causing any price pressure on said security, given that the trade in question does not reveal any new information about its fundamental value. Furthermore, should there be a temporary demand-supply imbalance for a given

security, a price increase or decrease would be instantly adjusted by arbitrageurs, recognising and exploiting the mispricing in question (Fama 1969).

The EMH has long been a paradigm in Financial Economics, and much of the research conducted since has been based on the assumption that it holds true, which has created a framework of normative theories for financial decision-making, all based on the fundamental assumption that financial markets function in a manner, which can be adequately construed as efficient. The notion of flat demand curves for financial assets has also influenced a wide range of accounting standards and financial services regulations that have been implicated in the global financial crisis (GFC).

The experiences associated with the Global Financial Crisis (GFC) and subsequent episodes of market stress have begun to challenge the assumption of flat demand curves. There is a growing academic consensus around the existence of asset price bubbles, the influence of behavioural factors and group psychology (e.g., herd mentality) on market liquidity, and the impact of market liquidity on valuation. This raises the question as to how the aforementioned policy changes were motivated. Were related empirical observations not documented prior to the GFC and, if they were, why did they not challenge the fundamental tenets underlying the EMH or moderate its influence on financial regulation?

This paper contributes to a growing body of literature that criticises the EMH and aims to show that while the GFC has been key in challenging the assumption of flat demand curves, there was already a large prior body of research documenting financial market anomalies – i.e. observations of asset price behaviour that seemingly contradict the EMH. Moreover, the paper proposes that a key reason why these findings did not hold sway is that efficient market theorists were successful in explaining away these anomalies, through use of what in a philosophy of science vocabulary might be described as *ad hoc hypotheses* and tautological reasoning.

Unlike the majority of papers criticising the EMH, which tend to originate from within the field of finance or focus on econometric aspects such as the empirical tests employed to validate its claims, this paper employs a perspective drawing on arguments from the Philosophy of Science discipline, aiming to show that EMH proponents have employed flawed scientific reasoning standards to protect the theory from being refuted. To the author's knowledge, this is the first paper

to provide a critique of the EMH by drawing on arguments from the discipline of Philosophy of Science.

The paper is structured as follows:

1) A background section that sketches the origins of the EMH and how it can be compared to Kuhn's notion of scientific paradigms.

2) A section that traces the influence of the EMH on financial regulation.

3) A review of a selection of research within the EMH paradigm, where evidence of financial market anomalies has been observed but where these have been interpreted as corroborations, rather than refutations of the EMH, through articulation of what Kuhn would term ad hoc hypotheses.

## Background

### *Kuhn's notion of scientific paradigms*

In an early passage of *The Structure of Scientific Revolutions,* Thomas Kuhn defines a paradigm as a scientific advance - original enough to attract a large group of adherents away from competing scientific methods - which functions as a *model* or *precedent*, creating a coherent tradition of research within the discipline in question – a definition of the concept chiefly relating to the social organisation of science in schools of thought connected with particular scientific achievements. [1] From this point on, research within the discipline becomes more focused and the problems more concrete and specific. Such a common ground for researchers also enables them to develop more sophisticated and exact instruments for measuring their object of study – this secondary effect gives rise to another definition of the paradigm concept, namely relating to the use of specific tools and instruments for the scientific undertaking in question (Kuhn 1996). Although these have been labelled as distinct conceptual definitions, in the actual scientific process they are intimately interlinked in the sense that one typically constitutes a condition of possibility for the other. The history of the Efficient Markets Hypothesis is a particularly illustrative example of this.

## *Origins of EMH*

The notion that stock returns are independent and follow a random walk was suggested as early as 1900, by Louis Bachelier, a French mathematician, in his Ph.D. thesis, 'The theory of speculation' (Bachelier 1900). This notion was taken up by a select group of academics at the University of Chicago Booth School of Business, notably by Eugene Fama in his published Ph.D. thesis (Fama 1965). The formal articulation of the Efficient Markets Hypothesis appears in Fama's 1969 publication 'Efficient capital markets: a review of theory and empirical work', which may be seen as somewhat of a revolution in the sphere of financial economics. His basic argument was that market prices were the best estimates of the intrinsic value of securities given all available information, since arbitrageurs or 'astute investors' would instantly observe and exploit to their benefit any mispricing of the security in question (Fama 1969).

Fama's arguments rest on previous research, notably what is sometimes termed *the Substitution Hypothesis* (see Scholes 1972 for a detailed discussion). This posits that the abundant quantity of shares issued on the market implies that there are always substitutes for a given stock, i.e., assets that represent claims to roughly identical income streams with similar risk. Therefore, there should be no reason why the price of any security should move away from that of a security with an identical risk/return profile, since arbitrageurs would otherwise immediately exploit the mispricing. [2] Together, these hypotheses imply that the demand curve for a financial asset should be flat around its intrinsic value.

Fama (1969) accordingly defines an efficient market as one in which changes in the volume demanded by investors will not cause the price of a security to shift, unless this coincides with new information being disseminated about the security. He then proceeds to categorise three versions of efficient markets (weak, semi-perfect, and perfect), where information is incorporated in securities prices to varying degrees. The weak level exists when security prices reflect all information contained in the record of past prices, and the midlevel exists when prices incorporate all publicly available information at any point in time. Finally, the strong level is evident when all existing information is incorporated in market prices, i.e., including insider information. Therefore, Fama's notion of market efficiency is quite narrow and hinges purely on how much information available. As such, it stands in contrast to broader definitions of market freedom

and efficiency that, e.g., consider the extent to which markets are exposed to frictions or external interference.

## *Spawning of sub-disciplines*

The EMH laid the founding-stone for what came to be called the *Chicago School* of academic research in Financial Economics and spawned off and/or profoundly influenced a large set of subdisciplines (e.g., Corporate Finance, Corporate Valuation, Portfolio Theory, Derivatives Pricing). While covering different areas of study, these disciplines all rest on the common assumption that the demand curve for financial assets is infinitely elastic, that securities markets are efficient, and prices unaffected by large changes in volume demanded, when these volume changes do not coincide with the dissemination of new information in the market. They also bear testament to Kuhn's description of how research within a paradigm becomes more focused and the problems more concrete and specific.

Examples of how financial research became more focused and devoted to specific problems following the articulation of the EMH include the Capital Asset Pricing Model or CAPM (Jack Treynor 1961; William Sharpe 1964; John Lintner 1965 and Jan Mossin 1966), one of the foundations of Portfolio Theory. Although drawing on earlier research on diversification by Markowitz (1952), the CAPM is profoundly influenced by the notion that arbitrageurs act to iron out all price anomalies. In the CAPM, the only residual factor influencing valuation is hence the relationship between risk and expected return, which in turn is based on investor risk aversion.

Another example of a subdiscipline is derivatives pricing, where the random walk theory of security returns, with its notion of share prices adjusting stochastically over time to the dissemination of new information in the market, was found to be consistent with a notion of asset prices following a lognormal distribution over some specified time measure. The argument was that if the intraday movements $r$ were random, and approximately following a normal distribution, then $1 + r$, corresponding to the ratio of the price of the today share to yesterday's, follows a lognormal distribution (defined as the distribution of a parameter X, whose natural logarithm follows a normal distribution).[3]

## *Development of tools and data sources for measurement*

Moreover, in his sequel *Efficient Capital Markets II*, Fama recounts how the various tests of the EMH have produced an entirely new and more precise toolbox for measuring the data in question, and he distinguishes between three types of tests: *tests for return predictability* using regression models, *tests for the adjustments of prices to public information* using event studies, and *tests for private information* (Fama 1991). According to Kuhn's notion of paradigm as a model, creating a coherent tradition of thought, but also creating the condition for more precise instruments and tools to measure study phenomena, it can easily be argued that the notion of market prices as the best estimate of the intrinsic value of a security represents a conceptual condition for the three types of tests characterised by Fama (1991). Tests for return predictability were originally developed as regression models, for instance, to test the assumptions of the CAPM, i.e., relating the historical average return of a security (relative to a market index) to its historical returns volatility. The rationale for conducting such a test would be absent without the key notion that security prices follow a random walk, but one that exhibits a systematic relationship between the magnitude of return fluctuations and the historical trend gradient of such return (due to the presence of investor risk aversion). The CAPM, in turn, created a benchmark against which tests for the adjustments of prices to public information might be carried out. In such tests, also called *event studies*, the deviation of individual stock returns from that predicted by a model (such as the CAPM) is measured to detect the influence of certain information events on security prices.

Even the financial data required for empirical studies of price behaviour can be seen as having come about with the aid of the EMH. The Centre for Research in Security Prices (CRSP) was launched by the University of Chicago business school dean, Jim Lorie, in 1960. Before that, there was no easily accessible longitudinal data on U.S. share price movements. Up to 3 million pieces of information on all shares traded on the New York Stock Exchange between 1926 and 1960 were transferred from paper in the Exchanges' archives to magnetic tape. The initial motivation was to investigate the empirical basis for the existence of an equity-risk premium, that is, whether stocks outperform less risky investments in the long run due to investor risk aversion (Fisher and Lorie 1964), and whether share prices follow a random walk, as suggested by Fama's

(1965) hypothesis. CRSP data allegedly provide the foundation for at least one-third of all empirical research in financial economics over the past 40 years. [4]

## *The EMH as a paradigm, creating conditions for 'normal science'*

Therefore, the historical account of the emergence of the EMH successfully demonstrates the positive effects associated with a Kuhnian paradigm, in the sense that it has created conditions for the conduct of 'normal science' in financial economics, due to which considerable advances have been made possible in our understanding of asset price behaviour. Kuhn also discusses a more negative aspect of scientific paradigms, however, in that researchers committed to a certain paradigm tend to hold on to weak theories, even in the face of substantial empirical anomalies. Empirical anomalies are observations that represent deviations from expectations that come with a certain theory or paradigm. They create uncertainty and disturbance in the practice of normal science. After a while, the anomalous observations accumulate to a crisis, in that the rules of the paradigm don't seem to work anymore. Researchers within the paradigm then try to resolve the crisis, typically by creating an *ad hoc hypothesis*, an adjustment to the original paradigm, which reconciles it with the observed empirical anomalies (Kuhn 1996). [5]

Kuhn's account of scientific progress can be seen as a polemic against Popper's critical rationalist view of science. Popper ([1959] 2002, p. 278) held that the truth content of scientific theories cannot be *verified* by scientific testing (as suggested by an empiricist scientific view or the observational-inductivist account of science) but can only be shown to be *false* by observation or experiment. A theory can thus only claim to be scientific if it is *falsifiable*. The worst types of theory are those that are tautologies, i.e., true by definition. In Popper's view, the advance of scientific knowledge is an *evolutionary* process characterised by his formula $PS_1 \Rightarrow TT_1 \Rightarrow EE_1 \Rightarrow PS_2$. In response to a given problem situation ($PS_1$), a number of competing conjectures, or tentative theories (*TT*), are systematically subjected to the most rigorous attempts at falsification possible, in a process Popper calls error elimination (*EE*). Theories that better survive the refutation process are not truer, but rather, more 'fit'—in other words, more applicable to the problem situation at hand ($PS_1$). The generation of theories

through scientific methods does not necessarily then lead to 'truth', but it can nevertheless reflect a certain type of progress: towards increasingly *interesting problems* (*PS*$_2$). For Popper, it is in the interplay between tentative theories (conjectures) and error elimination (refutation) that scientific knowledge advances toward greater problems (Popper ([1959] 2002).

Kuhn on the other hand, questions the custom of falsification in scientific activity. Drawing on a historical account of Galileo's struggle to prove Ptolemaic astronomy to be wrong, Kuhn showed how Ptolemaic astronomers held on to weak theories in the face of substantial empirical anomalies (which in Popper's account should have been refutations of Ptolemaic theory). He thus argues that scientific progress is not a continuous process of conjecture and refutation but should rather be seen as a dialectic process of normal science under a given paradigm interrupted by revolutionary developments where the old paradigm is superseded by a new one. Furthermore, he claims that falsifiability is not a meaningful way of comparing the merits of theories from different paradigms, since the paradigms represent fundamentally different worldviews and use different languages; they are in this sense *incommensurable* (Popper [1963] 2002), pp. 291-335).

The burgeoning amount of empirical research conducted in financial economics would be impossible to summarise in the current format, but suffice to say that a large amount of pricing anomalies have been found, often of the form that security prices are found to react to events that arguably signal no new information about the intrinsic value of the stock (e.g., sunshine and S&P 500 index addition/deletion). The proponents of the EMH have been challenged to account for these, and a schism within the academe has resulted, where one side attempts to interpret the findings within the framework of the EMH, while the rival side has developed a not-so-coherent alternative discipline, *Behavioural Finance*, which instead attempts to explain price behaviour using findings from the social sciences, typically attributing imperfections in financial markets to a combination of cognitive biases such as overconfidence, overreaction, representative bias, information bias, and various other predictable human errors in reasoning and information processing (see Shleifer 2000 for an overview). Interesting to note is that both sides are using similar methodologies and empirical test types to conduct research in their respective fields. One might hence argue that while the EMH paradigm may not be right in its assumptions,

it has arguably equipped researchers in Finance with a set of tools and a theoretical framework that has generated more valuable insights about the nature of Financial Markets than would have been possible without it.

## The influence of the EMH on financial regulation

While important advances in our understanding of asset price behaviour have been made possible by the EMH, the influence that it has had on financial regulation has been more problematic and targeted for much criticism, notably by Richard Posner (2010) in *The New Yorker,* who accused some of his Chicago School colleagues of being 'asleep at the switch', further saying that 'the movement to deregulate the financial industry went too far by exaggerating the resilience - the self-healing powers - of laissez-faire capitalism'. How can an academic hypothesis be responsible for the GFC, one might ask? This section examines three areas of financial regulation which i) have been influenced by notions related to the EMH and ii) have also been implicated in the GFC. These areas relate to accounting standards, banking sector, and investment fund regulation, respectively. The section has a European focus when tracing this influence, devoting particular attention to European legislation and financial sector regulation.

### *Accounting standards*

A key policy area that may be seen as influenced by the EMH relates to accounting standards, in particular for the valuation of financial instruments. Accounting standards have historically been guided by *the principle of prudence* or *convention of conservatism*. This goes back to the very foundations of the accounting practice and was a basis for the valuation of warehouse assets in the first balance sheets drawn up by French trading houses in the 17th century, rooted in the bankruptcy laws set out in the 1673 trading statute, *Ordonnance sur le commerce* (Richard 2005). The prudence principle states that when choosing between two solutions, the one that will be least likely to overstate assets and income should be selected. Pertaining to the valuation of current assets on the balance sheet, the prudence principle has historically been translated in various accounting jurisdictions to a rule that current assets should

be valued no higher than their acquisition cost (but may be written down in the case of significant and sustained devaluations).

Although arguably French in origin, the prudence principle came to underpin accounting standards as they developed across the globe. This has been explained in several different ways. Some see it as motivated by a necessity to temper the 'effervescent' entrepreneur, who naturally overstates the value of the business. The accountant thus becomes a steward, 'the ultimate in solidity and stability' who understates to ensure that the value he reports is no greater than the actual one (Sterling 1967). Parker (1965) on the other hand relates it to the origins of the UK accounting profession in insolvency practice, arguing that experience of liquidations, failures, and fraud influenced its attitude to business performance and valuation. This was also a period when the retail price level was falling. The lower of cost or market rule can thus be seen as a natural product of prevailing historical circumstances, a view confirmed by Edwards (1989). Bryer (1993) offers an alternative perspective, arguing that accounting procedures such as 'lower cost or market' and valuation of fixed assets at book value rather than replacement cost helped to depress profits and create secret reserves. This served the interests of investors against labour unions, arguing for higher wages, by deliberately understating the real profitability of companies at the time, thus limiting the room for negotiating salary increases.

While the prudence principle was initially applied to current assets of trading companies (i.e., mainly warehouse goods), the principle was historically applied also to financial services companies whose assets and liabilities were thus traditionally valued at amortised cost. The merits of the *prudence principle* versus fair value accounting have been intensely debated for a number of decades. An initial debate started amongst academics and accounting specialists in the 1970s, following the publication of the *Trueblood report*, and was heavily influenced by notions connected to the Efficient Markets Hypothesis. Following the stock market crashes of the late 1980s, the prudence principle regained some favour but started to come under attack again by the late 1990s, culminating in a number of new accounting standards, of which we will pay particular attention to the international standard for financial instruments (International Accounting Standard 39, or IAS 39).

The International Accounting Standards Board (IASB) is the global standard-setting body for accounting standards. Founded in April 2001, IASB is a private self-regulatory body that represents the accounting profession and seeks to harmonise accounting practices in its 15 member countries. Critical research on standard-setting has highlighted how changes in accounting standards tend to result from changes in the balance of power between actors that seek to influence them (see, e.g., Judge et al. 2010; Mattli and Büthe 2003). In this strand of inquiry, the IASB is frequently portrayed as captured by private interest (Chiapello and Medjad 2009), serving the needs of multinational enterprises and advocates of Anglo-Saxon accounting traditions (Perry and Nölke 2006), or alternatively the agenda of large international accounting firms (Suddaby et al. 2007; Whittington 2005). It has been argued that the power exerted by these stakeholders has made the IASB less responsive to lobbying from the public sphere (Power 2009), fostering standard setting based on a logic of capital markets orientation, with a wider use of market valuation seen to respond better to investor needs (Perry and Nölke 2005).

A breakthrough for the IASB came when the EU chose to adopt IFRS as common accounting standards for the Single Market. Which accounting standards to adopt was a controversial question at the time; opting for a solution provided by an independent standard-setter was seen as more politically neutral (Van Hulle 2004) and likely to better serve the needs of investors than hard law prepared by civil servants (Trubek et al. 2005). Such endorsement by a major global legislator has been argued as key in ensuring the success of the IASB as a global standard-setter (Martinez-Diaz 2005). In fact, IAS39 was the first IFRS standard that failed to pass the EU approval procedure, reflecting its controversial nature already before the crisis. In 2004, the EU endorsed a hybrid version of the standard, omitting certain sections of IAS39. Shortly after that, the IASB approved an amendment of IAS39, with a number of controversial elements removed, which was eventually endorsed by the EU in December 2005.

IAS 39 represented a step change in standards for the valuation of financial instruments and a marked departure from *the prudence principle*. According to the standard, financial instruments are to be recognised in the balance sheet of financial services companies (banks and insurers) as assets valued at fair value – depending to some extent on how they are classified (e.g. as traded vs. held to

maturity). Financial instruments classified as traded should be recognised at fair value, a valuation that should be made according to a 'fair value hierarchy', which ranks 3 levels of input based on the lowest level of input significant to the overall fair value.

1. Level 1 - Quoted prices for similar instruments.
2. Level 2 - Directly observable market inputs other than Level 1 inputs.
3. Level 3 - Inputs not based on observable market data.

Following the adoption of IAS 39, EU and other IASB member country banks had to report unrealised gains or losses in the market value of financial instruments in their balance sheets. Critics commented that commercial banks served a public interest, and their financial survival should thus not be made dependent on the whims of the financial markets and fluctuating valuation of securities. By recognising financial instruments in the balance sheet at fair value, one would be subjecting commercial banks to an unnecessarily high degree of balance sheet volatility, increasing the risk of financial insolvency. Notably, the European Central Bank (ECB) rejected the wide application of fair value principles, arguing that it would give banks much leeway for creative accounting and overstating their capital ratios (Kerwer 2007). The counterargument advanced by the IASB was that market prices reflected the best estimate of intrinsic security values, and by recognising financial instruments at fair value, accounting would become more transparent, painting a 'truer' and 'fairer' picture of financial health.

The argument that fair value accounting paints a truer and fairer picture of a bank's financial health may be considered ultimately founded in the view of securities markets as efficient, market prices seen as best estimates of the intrinsic value of securities given all available information – otherwise the picture painted would clearly not be deemed 'true' or 'fairer'. More specifically, the arguments are based on the assumption of completely elastic demand curves for financial assets, flat around the axis of the intrinsic 'true' value of a given security. Clearly, if the demand for stocks and/or other financial instruments were seen to be inelastic, that is, that the market price of a given security would be affected by large blocks of that asset being bought or sold in a short space of time, then recognising such instruments at fair value in banks' balance sheets

would risk overstating or conversely understate their true value, causing unwarranted balance sheet volatility and increasing the risk of bank insolvency.

Fair value principles have been blamed for allowing banks to recognise unrealised market value gains on financial instruments during the build-up to the GFC, boosting their profits and allowing them to increase dividends to shareholders. This made banks more vulnerable to a price correction in the corresponding securities, compared to if they had been booked at accrual value. When initial troubles in the Asset and Mortgage Backed Securities (ABS/MBS) market then started to brew, the recognition of unrealised losses caused banks to fire-sell assets that had rapidly depreciated in value, to try and get out of the market ahead of the competition, thus creating a downward spiral of depreciation that exacerbated the crisis (see Allen and Carletti 2007 for a discussion). Under pressure from the EU, the IASB responded to such criticism in the fall of 2008, by issuing a revised version of IAS 39. Bengtsson (2011) provides an account of the institutional power struggles surrounding this revision, which allowed banks to reclassify a traded portfolio as hold-to-maturity, without need for fair value recognition, under certain specified conditions.

## *Regulation of the banking sector*

A second policy area influenced by the EMH relates to the regulation of the banking sector. The Basel Accords are recommendations on banking laws and regulations issued by the Basel Committee on Banking Supervision (BCBS), primarily pertaining to the calculation of capital requirements and guidelines for sound risk management practices. Basel II is the second of the accords, and was initially published in June 2004, implemented in the EU via the Capital Requirements Directives, and voluntarily by a number of non-EU countries. All credit institutions thus bound by national law to adopt it had done so by 2008.

Basel II represents a significant departure from its predecessor, Basel I, in offering a spectrum of approaches to calculating the regulatory capital requirement for an individual bank, ranging from basic to advanced approaches for each of the regulatory Pillar I risk types (Credit, Market, and Operational risk). The standardised approach for credit risk, for instance, is conceptually very similar to Basel I, essentially requiring banks to hold an 8% proportion of risk-weighted assets as capital, with an accompanying lookup table of risk weights

for rated financial instruments and loans to rated counterparties, as well as loans to nonrated counterparties and retail mortgages/consumer loans.

The purpose of such a standardised capital requirement is to act as a 'cushion' of solvency against potential future losses (driven by credit, market and operational risks), thus ensuring a degree of maintained solvency in the banking system over time – stemming excessive leverage and providing protection for customer deposits. The purpose of the more advanced approaches to calculating each capital requirement is to provide a stronger link between the idiosyncratic risk pertaining to individual banks and their respective capital requirement. Thus, a bank taking a low amount of credit risk (by, say, only lending money to financially stable high-income earners with good credit history) theoretically should merit a lower relative capital requirement than a bank underwriting loans to people with no income and poor credit history. The Basel I accord was seen to distinguish insufficiently, in determining the respective capital requirements, between banks operating with fundamentally different credit standards.

How then to establish a stronger link between the capital requirement and the risk profile of individual banks? The BCBS, after consultations with academics, consultants, and the banking industry, came up with a statistically sophisticated framework. For credit risk, banks have the option to use the advanced internal ratings-based (IRB) approach, whereby mortgages and loans are rated using internally developed statistical rating models that assess the probability of default (PD), loss given default (LGD) and exposure at Default (EAD) of individual or groups of mortgages.

The models are calibrated using logistic regression techniques where a relationship between historical defaults and observable financial conditions pertaining to the loan/borrower in question are sought out (e.g., default is often found to be correlated with previous credit remarks and historical evidence of failure to pay monthly interest on loans). These parameters can then be used to fit a probability distribution function of credit losses (typically a Beta distribution), and the capital requirement can then be calculated as a certain confidence interval of that distribution (what is often referred to as an Economic or Internal Capital requirement). For the Pillar I IRB requirement, a simplified formula is provided in the Basel II directive. For the advanced market risk

approach, a VaR model is recommended, whereby a lognormal distribution is fitted to characterise the institutions proprietary portfolio of financial instruments, the capital requirement calculated as a confidence interval of said distribution. [6]

The notion of security prices following a random walk over time, with normally distributed returns, and a distribution of said returns, which can be parameterised using constant (historically assessed) mean and standard deviation, has been shown to be profoundly inadequate to base probabilistic estimates of ruin on. In real life, the volatility of the security price changes over time, showing a correlation with points in the business cycle. During recessions and associated 'bearish' stock markets, returns follow a downward trajectory with high volatility (extreme swings up and down), while in a bull market security prices follow a smoother upward trajectory. Capital requirements calculated accordingly are thus prone to procyclicality. After a long bull period with a stable and increasing price trajectory, capital requirements for market risk tend to go down, only to increase again in a bear market. Similarly, capital requirements for credit risk calculated according to the Internal Ratings Based (IRB) approach tend to decrease after a long period of low credit losses (Repullo and Suarez 2008).

Probability distribution functions based on a constant standard deviation or 'shape' parameter also generally tend to underestimate 'tail' events, that is, how bad things can go when they go really, really bad. Many banks were able to substantially lower their relative regulatory capital requirements (ultimately because the IRB approach and advanced market risk approach systematically underestimated credit and market risk), when moving to advanced approaches under Basel II. This enabled the banking sector to increase its systemic leverage, one of the chief culprits of the GFC, as remarked by Stefan Walter, Secretary General of the BCBS between 2006-2011.

Another weakness of the Basel II accord was its ignorance of liquidity risk. Liquidity risk can be broken down into market liquidity risk (the risk of not obtaining a buyer for the sale of a security) and funding liquidity risk (the risk of not being able to refinance maturing debt). As remarked by Stefan Walter, the pre-crisis financial system was characterised, *inter alia,* by 'insufficient liquidity buffers and overly aggressive maturity transformation' (Walter 2010). Overly

aggressive maturity transformation basically occurs when banks finance illiquid assets having long-dated maturity, with short-term debt. When the debt matures, the bank can theoretically refinance the asset by re-issuing new short-term debt, over and over on a rolling basis. Because of the liquidity premium causing upwards-sloping yield curves (i.e., short-term spot interest rate typically being lower than long-term rates), banks were able to make significantly more money this way, as compared to if they had maturity-matched assets and liabilities.

When/if the market for some reason refused to refinance said short-term debt, the bank would, however, find itself in trouble. This situation was what caused a large number of banks to go insolvent through failure to honour debt obligation or to stages of near bankruptcy where they had to be bailed out by the state (Kashyap, Rajan and Stein 2008). The arguments for not introducing regulations pertaining to liquidity risk in the Basel II directive were that capital is an inadequate prophylactic against liquidity risk. This has not prevented the Basel committee from issuing revised regulations, commonly referred to as Basel III, with rules setting out a mandatory liquidity buffer of highly liquid assets (cash and government bonds), the size of which is to be related precisely to the magnitude of the maturity funding mismatch (Basel Committee on Banking Supervision, 'The Basel Framework'). How came the sudden change of mind? Perhaps the prior counterargument was also rooted in a belief more generally influenced by the EMH, in the overall efficiency of financial markets, a worldview in which a severe liquidity crisis was simply unconceivable? If the demand curve for stocks and bank bonds is flat, then a bank should always be able to issue new debt. In addition, banks would never find themselves in a liquidity trap, since they would always be able to sell assets at their 'fair' value and thus pay back the maturing debt.

## *Investment fund regulation*

A third area of financial regulation, which may be seen as influenced by the notion of flat demand curves, relates to regulation of UCITS funds. UCITS stands for Undertakings for Collective Investment in Transferable Securities, a term that designates investment funds that comply with the European Commission's regulatory framework of the European Commission for managing and selling such funds. The first UCITS directive (Directive 85/611/EEC) was

adopted by the European Parliament in 1985 and set down common rules for open-end funds investing in transferable securities. The objective of a common legislative framework was that a fund authorised in one member state could be sold to investors in all member states, thus furthering the goal of a single market for financial services in the EU. Unlike closed funds, open-end funds allow unit holders to redeem their fund units at net asset value, typically with a relatively short notice period. To finance such redemptions, the asset manager often holds a buffer of cash or highly liquid assets but may also need to sell investment assets if the redemptions become too large or in order to maintain a target liquidity ratio. Beyond the requirement that the assets are transferable (typically held to mean that they are registered for trading on a securities exchange), the UCITS directive originally imposed no constraints on the market liquidity of the securities an asset manager could invest in, nor did it provide for any minimum cash buffer requirement or means to limit redemptions, although the directive is complemented by national legislation in some member states. An asset manager of a UCITS fund may thus invest in equities, sovereign bonds, corporate bonds and/or derivatives.

There are several reasons behind the limited liquidity requirements for UCITS funds in the early versions of the directive. One reason is that mutual funds were seen to be comparatively safer than banks. Since fund units are valued at market prices, investors have less incentive to redeem them during market turmoil, compared to deposit-holders in a troubled bank, who may be able to withdraw savings at their fixed nominal value if they act fast enough. The subcategory of money market funds (MMFs) was seen as a particularly safe and higher-earning alternative to bank deposits due to the high quality of bonds they invest in. Before the Great Financial Crisis, there was a significant body of research showing that MMFs typically experience inflows during episodes of market turmoil, suggesting that they may have a stabilising effect on the financial system (Miles 2001; Pennacchi 2006). More broadly, the notion that demand curves for financial assets are fully elastic may be seen to have influenced the logic that a sufficient requirement for a fund to be open-ended was that it invests in transferable securities. As long as there is a market where the securities can be bought or sold, the asset manager should be able to liquidate them at the prevailing market price to finance redemptions.

In an instance of irony, MMFs have been highlighted as a key intermediation channel in the build-up to the US subprime crisis. Gorton et al. (2010) find that the shadow banking sector, a system of financial actors that were not subject to banking supervision, played a significant role in enabling a build-up of risks that could not be properly understood when the crisis struck. Money market funds offering a substitute for bank deposits were used to finance securitised mortgages through repo transactions. This system allowed loans to be underwritten and financed without being subject to the same supervision and regulation that surrounds the banking sector. Although the share of troubled assets held by MMFs was relatively small, the lack of transparency caused investors to panic, and MMFs started to experience significant outflows in 2008, both in the US and Europe (see Dwyer and Tkac 2009 and Bengtsson 2013 for an account). These redemptions caused further price pressure on already troubled asset segments, as asset managers struggled to sell the securities in their portfolios, leading to a spiral of higher redemptions and further price falls (Brunnermeier and Pedersen 2008). Banks that relied on MMF investors as a financing source also found it difficult or more costly to refinance due-dated bank bonds.

The turmoil in the MMF market during the GFC has been followed by subsequent instances of redemption-driven price pressures, the most prominent example being the March 2020 dash for cash in the corporate bond market (Falato et al. 2021; Haddad et al. 2021; Dunne et al. 2023). These experiences have led the European Commission to open negotiations for a sixth revision of the UCITS directive. Notably, the new proposals include provisions for macroprudential instruments that may be imposed by national supervisors, including redemption gates, swing pricing, and requirements to match redemption terms to the liquidity of the underlying investments. A related policy discussion on whether central banks should extend refinancing facilities to nonbanks has also been reignited (Buiter et al. 2023; Fauvrelle et al. 2023).

## *Summary*

To summarise, fair value accounting standards allowed banks to recognise unrealised market value gains, boosting profits and enabling them to increase dividends, while internal models allowed them to lower their capital requirements for credit and market risk. Both factors combined to increase the

leverage of the banking sector, making it more vulnerable to price correction. The omission of liquidity risk from the Basel II standards furthermore allowed them to run a substantial funding mismatch, making them more vulnerable to refinancing risk. And the absence of liquidity requirements for UCITS funds caused the market for bank bonds and asset-backed securities to shut down, following an excess of supply driven by redemptions from fund investors. In all cases, this was made possible by economic policies influenced by the EMH-linked notion of elastic demand curves for financial assets.

With the hindsight of the global financial crisis, one wonders how such considerable reforms could have been implemented, when they seem to jar with how markets function. Were markets simply more efficient prior to the GFC? The next section will review some of the research carried out to test the elasticity of demand for financial assets, to demonstrate that empirical findings have long suggested that large changes in the demand volume for financial assets do impact prices. The reason why such findings did not forestall e.g. the adoption of IAS 39, is that they were interpreted by EMH researchers in a manner which did not refute the central tenet that demand curves for financial assets are flat. This behaviour is in line with Kuhn's theory of how an academic community responds when its scientific paradigm is threatened.

## Review of the EMH research on anomalies

In this section, we will review a selection of research into asset price anomalies, where defenders of the EMH have attempted to explain findings suggestive of price pressure through articulation of what Kuhn would call *ad hoc hypotheses.* The selection focusses on research into stock price anomalies, but the arguments developed in this strand of the literature have been used more broadly to explain pricing anomalies across a spectrum of asset classes. As such, they have had a profound impact on the shaping of financial regulation and the broader public debate on the role of financial markets in the economy.

### *Early attempts at explaining observed asset price anomalies*

Before the publication of Fama's papers (1965, 1968, 1969), many researchers shared the opinion that a firm's stock is a unique asset with an inelastic or kinked, demand function, and therefore when the firm increases its amount of

shares, these will have to be sold at a discount. Some stretched the argument further to mean that the same would hold for shareholders wishing to offload large blocks of shares (see Durand 1959). An early attempt to explain the empirically observed share issue discount was made by market efficiency theorists, using *the Information Hypothesis* (see Scholes 1972 for a discussion). This basically posits that large stock transactions contain implicit information value, thus causing the often-observed price adjustments. Since there are large costs to finding information of value about a share, and one would suspect that the buyers/sellers of large blocks of stock possess more information than buyers/sellers of small quantities, the large-block transactions are likely to contain more information than small-block ones. Therefore, small trades may be effected at very little information discount from previous trades, while large trades could only be sold at a lower (or bought at a higher) price to reflect the expected value of information contained in these trades. Applied to share issues, it is often used in conjunction with *the Pecking Order* theory used in corporate finance, which stipulates that share issues are the most expensive financing choice for companies, so that they would only choose it when retained earnings and debt financing were out of the question (or if the stock were overpriced). Therefore, a share issue implies information that the company is in trouble (or its stock overpriced), which causes a share price decrease and forces the company to issue the stock at a discount. Although this explanation is plausible at face value, it also brings to mind Kuhn's notion of ad hoc hypotheses (Kuhn 1996). Rather than refute the hypothesis of elastic demand curves, efficient market theorists have created an ad hoc hypothesis that explains the observed anomaly in a manner consistent with the prevailing paradigm.

However, to find ways of corroborating the hypothesis of flat demand curves, a key aim of EMH proponents has been to isolate 'non-information events', in hopes of demonstrating that certain large block sales do not result in price changes, because they are unambiguously information-free. Isolating such events has been a problem, since virtually any large change in the trading volume of a security – whose price is based on uncertain future cash flows - may be interpreted as information about the security in question. An early attempt at solving this dilemma was made by Scholes (1972). Since primary share distributions might imply information content, he chose to study the effects of secondary distributions instead. These are made when large shareholders

contact an investment bank to sell an excessively large block of shares, to a group of investors paying a commission-free subscription price. Because it is not sold directly on the market but to a select group of customers informed about the reasons for the deal, it may be seen as having little information content. While Scholes observed a nonreversed negative price adjustment of approximately 2%, corresponding to the proportion of total outstanding stock and thus suggesting an elasticity of -1, he chose not to interpret this as a refutation of the hypothesis that demand curves for stocks are fully elastic. Instead, he argued that 2% corresponds to the average commission paid by investors for share purchases, which, he argues, might explain the price adjustment. Again, while Schole's explanation is plausible, it can also be seen as another example of an *ad hoc hypothesis*. Rather than refute the hypothesis of elastic demand curves, Scholes creates a new hypothesis that explains the anomaly; when investors sell large blocks of shares commission-free, they have to sell them at a discount corresponding to the average commission price. However, the observation might just as well be interpreted to mean that investors cannot sell large blocks of shares at the prevailing market price but instead have to offer them at a discount. Crucially, subsequent studies have also put Scholes explanation into question by identifying a permanent price effect on the announcement date of the secondary share distribution (Mikkelsen and Partch 1985), which is difficult to reconcile with the transaction cost explanation provided by Scholes.

## *A tautological theory?*

A Popperian-inclined observer might react to the tautological nature that the EMH acquires, when combined with the *Information hypothesis*. A rhetorical tautology can be defined as a series of statements that comprise an argument, whereby the statements are constructed in such a way that the truth of the proposition is guaranteed or that the truth of the proposition cannot be disputed. In propositional logic, a tautology is a formula or assertion that is true in every possible interpretation. Taken to the extremes implied by the Information hypothesis, the core arguments of the EMH imply that you can never falsify the proposition that demand curves for securities are elastic around the intrinsic price of said security. Let A be the proposition that the demand curve for financial assets is infinitely elastic. Fama (1969) argued that this implies that changes in demand for a financial asset have no impact on its trade price

(proposition B). The propositional formula then becomes A→B. For this propositional formula to be falsifiable, it must be logically contingent. This means that it should be possible to make it true or false based on the values assigned to its propositional variables. In other words, if A is false, then B is false as well.

But when combined with the *Information hypothesis*, the proposition that demand curves for financial assets are flat is also proportional to changes in demand that cause a price impact (⌐B). The propositional formula then becomes A→B ∧ A →⌐B. Thus modified, the propositional formula is true for all values of B, and hence not logically contingent and, as a result, unfalsifiable. Put differently, if a large-block trade is not observed to result in any price change, an EMH proponent will see it as corroboration of the hypothesis of flat demand curves. But if the trade does result in a higher or lower valuation of the security in question, he will instead claim that it is because the trade in itself, by virtue of being so large, was seen by the market to contain some implicit information about the security. Combined with the *information hypothesis,* the hypothesis of flat demand curves becomes unfalsifiable and would thus seem to qualify for what Popper would term bad science.

Beyond being unfalsifiable, a tautology formulated along the principle A→B ∧ A →⌐B has a form similar to the *reductio ad absurdum* argument, by which a proposition is proven true by showing that the opposite claim would lead to a contradiction. In the case of the EMH, a latent contradiction arises when combining it with the *Information hypothesis*. If all large trades carry information value and cause a price decrease, there is nothing in the EMH that is materially different from a view that price is a function of volume, i.e., that demand curves for financial assets slope down.

## *Challenges to the Paradigm*

Eventually, a group of academics became sceptical of the basic tenets of the EMH and started to think about how they could come up with ways of refuting it. The task was not easy, since the implications of the *Information Hypothesis* are so broad that it is possible to harbour a lot of seemingly anomalous price behaviour under its roof. Therefore, a key objective was to identify 'non-information events', i.e. events that cause a large change in the trading volume of a security, but that

unambiguously do not contain any new information about future performance of the stock. Two pioneering studies in this respect were conducted by Harris and Gurel (1986) and Shleifer (1986), who analysed the share price and volume effects of inclusions and exclusion in the S&P 500 index. Stocks are replaced in the S&P 500 index, for instance, when they are acquired by or merged with another company, when they become too small, or to reflect changes in the geographic and economic composition of the US economy. Thus, index replacement should not incorporate any information content about the underlying company *per se.* The information should already have been available in the public domain for some time when the index change takes place.

Many asset managers maintain portfolios that mimic the composition of certain indices, on behalf of institutional or individual investors. When the composition of the index changes, so does the demand of these investors for the securities being replaced – in the case of passively managed index funds, the change in demand change is more or less the result of a computer automatically submitting a new limit order, to maintain an identical composition of the index fund to that of the underlying index. Given that the market does not view these securities to have a perfect substitute (contrary to *the Substitution Hypothesis*), the price change would be sustained over time. Should the price revert over the medium term to its initial level, there would still exist arbitrage opportunities that pose a challenge to the semi-strong version EMH, since this suggests that security prices are adjusted instantly to compensate for new information, or for the non-information reflected in a specific trade. Both Harris and Gurel (1986) and Shleifer (1986) obtained results suggesting that demand curves for stocks are indeed not flat but that changes in demand cause sustained price reactions (though reversed after some time, in the Harris and Gurrel study), even though the trades incorporate no new information about the security. These findings spurred a renewed focus on price anomalies and gave strength to the then emerging *Behavioural Finance* discipline.

While the Information Hypothesis suggests that large trades may contain information value, this argument seems strenuous to apply to index reweightings; a large trade containing no information (and which can readily be verified not to do so by checking who was the purchaser – index fund purchasers would suggest an automatic portfolio reweighting rather than investor

speculation) nevertheless causes the market to believe it contains information, thus adjusting the price upwards. This would not be a credible argument for an efficient market, rather the contrary, at least unless the index reweightings happen to coincide with an exactly simultaneous hike in expected future performance. This is something that Shleifer tested for in his study, by comparing the stock inclusions in the S&P with the credit rating imposed by the same institution after the inclusion. Shleifer found no significant relationship between the two events, although credit ratings are, of course, not the only proxy measure of the implicit information contained in index inclusions.

Significantly, Standard and Poors has the outspoken policy that index replacements should not be made according to new information on the stock. However, this explicit constraint does not necessarily mean that there is no implicit information released. Some of the criteria are more of an intangible character and difficult to measure. These criteria include managerial, financial governance, and capacity for producing information, matters that might only come out to their full extent during meetings with stock exchange representatives prior to the enlistment. Analysing these criteria is an ambiguous exercise but suggests that the inclusions may involve potential non-public information, especially in cases where the competition among companies for being listed is high. However, this hypothesis does not explain why the addition effect has grown stronger over time (in the US), parallel to the growth in index funds.

In addition to the studies mentioned studies, a comprehensive and important study to test for new data. This is a much longer paper, which elaborates more on the substitution hypothesis and discusses the results at length. Their approach was to directly test the reasons for the sloped demand curve, and their results suggested that demand curves transform from flat to sloped due to the dynamics of risk involved in the arbitrage process, which according to classical finance theory keep demand curves flat. The risks associated with arbitrage are, according to Wurgler and Zhuravskaya (2002), mainly the inability for arbitrageurs to find close substitutes to the stocks in question. This leads to the fact that it is very difficult for investors to short-sell a stock and go long in a substitute stock and choose the stock or portfolio in such a manner that the return streams do not cancel each other out. Wurgler and Zhuravskaya (2002) suggested that the closer substitutes one finds to the stock in question, the

higher are the opportunities for arbitrage activities and the flatter would the demand curve be. Consequently, the demand curve would also be flatter the less risk averse are arbitrageurs, when the heterogeneity of nonarbitrageurs is low, and when the number of arbitrageurs is higher. The empirical results of Wurgler and Zhuravskaya (2002) supported their hypotheses. The most surprising finding is that it is very difficult to find substitutes for the stocks in their data. For the median stock, they find substitutes that hedge only a quarter of the of the stock's daily return variance, which would suggest an $R^2$ of around 0.25. The implication of this is that stocks do have idiosyncratic risk-return relationship, undermining the previously mentioned *substitution hypothesis*.

In addition to the papers reviewed above, a broader body of critique against the EMH from fields more tangential to the finance discipline has been growing over time, including epistemological arguments related to the difficulties in quantifying human action and uncertainty (Rothbard 2004) and the fact that markets are in practice never free from external interference that systematically distorts the information content in securities prices (de Soto 2006).

## *Renewed attempts at explaining anomalies*

The above findings were understandably seen as controversial by adherents to the EMH, and a series of studies aimed at investigating the effects of index reweightings followed. As most empirical studies continued to note significant price changes, often sustained, EMH adherents have come up with a number of alternative explanations for the phenomenon, all of which, as we shall see, have the nature of *ad hoc hypotheses*. The following EMH-faithful explanations have been suggested:

- First, a rearticulation of the *Information hypothesis,* called the *information signalling* hypotheses (Jain 1987; Dhillon and Johnson 1991; Denis et al. 2003), states that a stock that is added to an index is by definition good news (with the contrary being true for deletions). These authors argue there could be many reasons as to why this is the case: Some indices, like the S&P 500, are decided upon by a committee operating according to loosen criteria, and being added to the index hence could reflect something positive about the stock. Another reason is the fact that belonging to the top echelon of stocks allows for more attention

from investors, analysts, and the media. According to this hypothesis, a stock price effect would be expected to be permanent.

- Second, the *information costs/liquidity hypothesis* (Van Horne 1970; Barry and Brown 1984; Beneish and Gardner 1995) states that index inclusion can increase the amount of information available in the public domain about the stock as well as lower the cost of acquiring more information. The reason for this is the scrutiny and attention that journalists and analysts typically devote to companies in the major indices. Another possible effect of this increased information flow may be the narrowing of bid-ask spreads and, as the corollary, a lowering of total transaction costs. According to this hypothesis, index inclusion should lead to lower costs of trading and hence to a permanent price increase for the stock.

Behavioural finance researchers, on the other hand, typically favour the *price pressure and imperfect substitutes* hypothesis (Kraus and Stoll 1972; Hess and Frost 1982), which posits that adding a stock to an index can lead to an increase in demand for that stock. Reasons for this include the fact that index inclusion attracts increased buying both from index funds needing to replicate the index and from active portfolio managers who benchmark themselves to the index and investors hedging bets in the options and futures markets. Additionally, investing in the major indices is an easy way for foreigners to gain exposure to a market, which also contributes to increased demand. Depending on the nature of the stock price effect (whether it is merely temporary or more permanent), we arrive at either the *price pressur*e hypothesis or the *imperfect substitutes* (also known as *downward-sloping demand curves*) hypothesis.

Below is provided an overview of the research undertaken in the field, as well as the respective hypothesis that the findings lend its weight to.

**Table 1** Overview of research on price effects of index changes

| Author(s) | Indices | Period | Object of investigation | Supported hypothesis |
|---|---|---|---|---|
| Shleifer (1986) | S & P 500 (USA) | 1966-1983 | Effects of price and volume effects of additions | *Imperfect substitutes* |
| Harris / Gurel (1986) | S & P 500 (USA) | 1973-1983 | Price and volume effects of additions and deletions | *Price pressure* |
| Jain (1987) | S & P 500 (USA) | 1977-1983 | Price effects of additions and deletions | *Information signalling* |
| Pruitt / Wei (1989) | S & P 500 (USA) | 1973-1986 | Changes in institutional holdings after additions and deletions | *Imperfect substitutes* or *Price pressure* |
| Dhillon / Johnson (1991) | S & P 500 (USA) | 1978-1988 | Price (stocks and options) and volume effects of additions | *Information signalling* |
| Beneish & Whaley (1996) | S & P 500 (USA) | 1986-1994 | Price effects of additions | *Price pressure* |
| Lynch / Mendenhall (1997) | S & P 500 (USA) | 1990-1995 | Price and volume effects of announcements and realisation of changes in index composition | *Imperfect substitutes* and *price pressure* |
| Erwin / Miller (1998) | S & P 500 (USA) | 1984-1988 | Effects of price and volume effects of additions | *Price pressure* |
| Liu (2000) | Nikkei 500 (Japan) | 1991-1999 | Price and volume effects of announcement of changes in index composition | *Imperfect substitutes* |
| Bechmann (2002) | KFX (Denmark) | 1989-2000 | Price and volume effects of announcements and realisation of changes in index composition | *Imperfect substitutes* and *information costs/liquidity* |
| Wurgler / Zhuravskaya (2002) | S & P 500 (USA) | 1976-1989 | Price effects of realization of additions | *Imperfect substitutes* |
| Denis et al (2003) | S & P 500 (USA) | 1987-1999 | Price effects of announcement and realization of additions | *Information signalling* |
| Hedge and McDermott (2003) | S & P 500 (USA) | 1993-1998 | Effects of price and volume effects of additions | *Information costs/Liquidity* |
| Gerke / Fleischer (2003) | MDAX (Germany) | 1996-2002 | Price effects of announcement and realisation of changes in index composition | *Price pressure* |
| Biktimirov / Cowan / Jordan (2004) | Russell 2000 (USA) | 1991-2000 | Effects of price and volume of realization of changes in index composition | *Price pressure* |

| Author(s) | Indices | Period | Object of investigation | Supported hypothesis |
|---|---|---|---|---|
| Chen / Noronha / Singal (2004) | S & P 500 (USA) | 1962-2000 | Price and volume effects of announcement and realisation of changes in index composition | Unclear |
| Pape / Schmidt-Tank (2004) | STOXX 50 (Europe) | 1998-2003 | Price and liquidity effects of announcement and realisation of changes in index composition | Unclear – no support for liquidity hypothesis |
| Chakrabarti et al. (2004) | 29 MSCI Country Indices | 1998-2001 | Price effects of announcement and realisation of additions to the index | *Imperfect substitutes* and mild *liquidity effects* |
| Shankar / Miller (2006) | S & P 600 (USA) | 1995-2002 | Price effects of announcement and realisation of additions to the index | *Price pressure* |
| Mase (2008) | FTSE 100 (UK) | 1992-2005 | Price and volume effects of announcements and realisation of changes in index composition | *Price pressure* |

Note: This table provides an indicative and no exhaustive overview of the key research performed to date in the area of stock price effects in conjunction with index changes. Columns 3, 4 and 5 represent the studied time periods, the specific topic investigated, as well as the supported hypothesis that arises from the study, respectively.

As can be seen from the above overview, there is no clear consensus on the reason for the observed price effects following index changes. The *Information signalling* and *Information costs/liquidity hypotheses* are advanced about as often as the *Imperfect substitutes* and *Price pressure* hypotheses. Why is this heterogeneity a problem, one might ask? To be sure, the notion that investors perceive large block trades to contain implicit information and thus meriting a price adjustment of the associated security can be seen both from a market efficiency perspective, and one that favours behavioural explanatory factors. In this sense, it corresponds to Kuhn's view that facts are always the result of interpretations (Kuhn 1996). For while the efficient market theorist sees an inelastic/flat/horizontal demand curve shifting down, the result of market prices adjusting to new information relating to the intrinsic price of a security (caused

by the large size of the very trade itself), the behaviour finance theorist sees an inelastic/downward sloping demand curve shifting to the left. What is the observed fact in this hypothetical observation and what is interpretation? From a scientific perspective, openness to different interpretations should certainly be encouraged.

When it comes to financial regulation, the issue becomes more problematic. If the demand curve for stocks and other financial assets is *not* flat, then abrupt changes in the aggregate volume demanded of a certain asset class may cause significant price changes. If the assets are recognised at fair value, this would affect the profitability and solvency of banks holding such assets in a way that makes the financial system less stable. The problem then lies in that the EMH view has been much more influential in shaping financial regulation in the run-up to the GFC, arguably going too far in attuning the financial system to fair value principles. The argument that 'the market is always right' was central in the adoption of IAS 39; that price changes associated with large block trades simply represent a readjustment of the equilibrium price to a new level, as such, there is no reason why such price changes should not be reflected in the bank balance sheets. As demonstrated by the above literature survey, there exists a substantial body of research (carried out prior to the GFC) that claims that large changes in demand volume *do* lead to price changes – the question is why these findings were brushed aside in the IASB's proceedings.

The core argument of this paper has been that one of the reasons for the enormous influence on policy may be found in Kuhn's account of how researchers within a paradigm tend to behave when confronted with anomalies; how they tend to construct *ad hoc hypotheses* to reconcile the findings with the dominant paradigm. EMH researchers have been quite simply successful in explaining away anomalous findings that would otherwise refute the notion of flat demand curves for financial assets. As a result of these attempts, the view that financial markets are efficient prevailed, at least until the onset of the Great Financial Crisis. Another key point of the paper is that this view prevailed, despite the fact that the key arguments advanced by the proponents of EMH were of a tautological nature, failing to meet Popperian standards of scientific reasoning.

Here, Lakatos (Lakatos and Musgrave 1970)'s idea of progressive and degenerating research programmes offers a complementary way to understand

the state of Finance research within the EMH paradigm in its later phase. Quoting Hacking (2000, p 70), 'For Lakatos, a program is empirically progressive if the successive theories make new predictions not covered by predecessors, while retaining most earlier corroborated predictions. It is conceptually progressive if its theories regularly produce new concepts with rich and simplifying structures…A program is degenerating if it lacks these virtues and if, when confronted with difficulties, it produces new theories that merely skirt the problem, saying "none of our business".' Producing new theories that merely skirt the problem (such as the Information Hypothesis) when confronted with difficulties is an apt description of the state of Finance research within the EMH paradigm in its later phase. In doing so, researchers within the field have contributed to an excessive belief in the self-regulating powers of financial markets, which has influenced a range of policy changes that bear much of the blame for the GFC.

## Conclusion

This paper has employed a perspective drawing on arguments from the Philosophy of Science discipline to examine the role of the Efficient Markets Hypothesis in financial research, as well as its influence on financial regulation. Drawing on Kuhn's notion of scientific paradigms, the case is shown that financial research became more focused following the articulation of the EMH and the problems more concrete and specific. In addition, more precise tools and methodologies for measurement were made possible. In addition to these positive aspects of what Kuhn calls 'normal science', a more problematic tendency has been discussed to explain anomalous findings through articulating *ad hoc hypotheses.*

Researchers working within the EMH paradigm have ultimately been successful in defending the hypothesis of flat demand curves for financial assets from being refuted, despite empirical findings to the contrary. As a result of these attempts, the view that financial markets are efficient prevailed, at least until the onset of the Great Financial Crisis. This is identified as a key reason for the influence that the EMH has had on accounting standards, as well as banking sector and investment fund regulation. A second point of the paper is that this view prevailed, even though key arguments advanced by EMH proponents were of a tautological nature, failing to meet Popperian standards of scientific reasoning.

The paper thus contributes to a growing body of literature that challenges the underlying tenets of the EMH by adding a novel dimension of critique. While the majority of papers criticising the EMH tend to originate from within the field of finance or focus on econometric aspects, this is the first paper to provide a critique of the EMH by drawing on arguments from the Philosophy of Science discipline.

Following the GFC and subsequent episodes of less market strain, we have learned that many of the policy reforms motivated by arguments linked to the EMH contributed to shaping an economy that was inherently more fragile. In other words, the consequences of allowing a worldview shaped by the EMH to exert an enormous influence on financial regulation have proven disastrous. A potential lesson that may be drawn from this is related to the use of scientific standards in the screening of research used to motivate economic policy changes. More rigorous vetting of the findings used to motivate them may have prevented or moderated some of the policy changes discussed in this paper. On the other hand, the paper also demonstrates how difficult this is to achieve in practice, since adherents to a scientific paradigm have strong stakes in defending it and will employ a range of strategies to salvage it from refutation.

Following the experiences of the GFC, the IASB have resorted to more prudent principles and accounting standards for asset valuation (replacing IAS 39 with IFRS 9), the revised version of the Basel framework provides for capital buffers related to systemic risk, and the proposed amendments to the UCITS framework include macroprudential tools that may be used by national supervisors to mitigate liquidity strain from investment funds. More broadly, a new field of financial regulation related to macroprudential policy and financial stability has emerged with the objective to prevent and containing future financial crises. While one might take comfort in concluding that this has strengthened the resilience of the financial system to shocks, lowering the risk of future financial crises occurring, the account provided in this paper illustrates the importance of remaining vigilant against flawed scientific reasoning as a key safeguard to prevent economies from being made vulnerable by inappropriate policymaking. This is especially pertinent at the current juncture, with strong worldwide pressures to shape policymaking along a protectionist trajectory, including

proposals to strengthen regional financial sectors through deregulation and relaxation of standards.

## Endnotes

[1] While critics of the philosopher Thomas Kuhn have pointed out that he uses the paradigm concept in no less than 21 different ways (Masterman 1970), this is a commonly accepted definition.

[2] An early discussion of the substitution hypothesis is to be found in Miller and Modigliani (1961).

[3] The lognormal model of asset prices, or more generally an assumption that the distribution of asset prices over time can be approximated with a parametric statistical distribution (such as the lognormal), is the key condition for closed-form option pricing theory, an example of which is the *Black-Scholes* model.

[4] *The Economist*, November 20, 2010, p 82.

[5] It may be noted that Kuhn's notion of scientific paradigms bears a strong resemblance to Lakatos' notion of scientific research programmes (Lakatos and Musgrave 1970), characterised by a hard theoretical core and surrounded by a protective belt of additional theories.

[6] This text is a summary of the Basel II directive. A full text version can be found at: http://www.bis.org/publ/bcbs128.htm.

## Conflict of Interest Statement

The author declares that he has no conflicts of interest to disclose.

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Mathias Skrutkowski is a Ph.D. student at Lund University, Lund (Sweden) (mathias.skrutkowski@fek.lu.se).