Freshwater, Saltwater, and Deepwater: Efficient Market Hypothesis versus Behavioral Finance

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Abstract

The efficient market hypothesis (EMH) and behavioral finance (BF) form the blame-hope axis of the ongoing soul-searching exercise in economics, which frequently refers to the 'Chicago School' and the ideological division between 'freshwater' and 'saltwater' universities. Citation analysis for 1965-2010 shows that these simple geographical anecdotes do not apply, as saltwater economists heavily cited the seminal EMH papers from the beginning, and vice versa. BF lags behind EMH in terms of the quantity, dynamics, scope, and international reach of citations. BF is far from stealing a march on the EMH, and the latter is still used as the benchmark.

Keywords: efficient market hypothesis, behavioral finance, Chicago School, 'saltwater' economics

JEL codes: A14, B26, G02, G14

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Introduction

The global financial crisis that exploded in late 2008 has unleashed a heated debate and a soul-searching exercise in economics. At a Congressional hearing in October 2008 Alan Greenspan admitted that he was in a state of "shocked disbelief" because 'the whole intellectual edifice" had "collapsed" (Greenspan 2008). Paul Krugman argued that much of the past 30 years of macroeconomics was "spectacularly useless at best, and positively harmful at worst" (*The Economist* 2009). On the other side of the Atlantic, John Kay (2011) has criticized the methodological approach of economics as dedicated to deductive reasoning and use of mathematics while marginalizing other epistemological strategies. Our objective in this brief introduction is to highlight three recurring themes permeating this debate that motivate our research questions.

The first leitmotif is the use of geographical metaphors, starting with the idea of the Chicago School. Joseph Stiglitz was quoted to say: "the Chicago School bears the blame for providing a seeming intellectual foundation for the idea that markets are self-adjusting and the best role for the government is to do nothing" (Interview with Lippert 2008). In a sweeping statement, typical of the debate, John Lippert of Bloomberg writes: "For half a century, Chicago's hands-off principles have permeated financial thinking and shaped global markets, earning the university 10 Memorial Prizes in Economic Sciences starting in 1969, more than double the four each won by Columbia University, Harvard University, Princeton University and the University of California, Berkeley. Chicago's laissez-faire imprint underpins everything from U.S. President Ronald Reagan's 1981 tax cuts and the fall of communism that decade to quantitative investment strategies" (2008). Bradford DeLong (2009) stresses the continued negative influence of the Chicago School: "there are a substantial number of economists – most but not all of them associated with Milton Friedman's University of Chicago and his Chicago School – who are (…) saying that the world's central banks and governments should not be taking action to support global asset prices right now and should not be worried about heading off or reducing the current rise in global unemployment".

The notion that the Chicago School is part of a broader saltwater-freshwater distinction was first conceived by Stanford professor Robert E. Hall in 1976. Hall observed the influence on federal US economic policy-making of 'freshwater economists', who were largely affiliated with the University of Chicago and other schools clustered near the Great Lakes, including the University of Minnesota and the University of Rochester (Kilborn 1988). Freshwater economics is typically caricatured as heavily reliant on mathematics and concerned only with its own internal consistency rather than empirical validity (Kay 2011). By contrast, 'saltwater economists', who are influenced more by Keynesian economics, tend to be based at coastal US universities. One of the most fundamental assumptions dividing fresh and saltwater thinkers is the rational-expectations model of human behaviour. Whereas freshwater thinking is generally underpinned by an assumption that the rational-expectations model broadly holds, saltwater scholarship is more concerned with anomalies in the theory. As evident in the preceding passage, the divide between the two schools is also rooted in clear differences in political ideology : while freshwater

economists have greater faith in the ability of free markets to function well, saltwater economists are more supportive of government intervention. According to some the intellectual battle between freshwater and saltwater lives on. As Krugman claimed "there hadn't been any real convergence of views between the saltwater and freshwater factions" (Krugman 2009).

The second leitmotif in the debate is the efficient market hypothesis (EMH), which features as probably the most frequent object of attacks. In a sequence of fiery accusations Krugman (2009) states: "Among financial economists, Keynes's disparaging vision of financial markets as a "casino" was replaced by "efficient market" theory, which asserted that financial markets always get asset prices right given the available information. (…) Discussion of investor irrationality, of bubbles, of destructive speculation had virtually disappeared from academic discourse. (…) In short, the belief in efficient financial markets blinded many if not most economists to the emergence of the biggest financial bubble in history". Joining the critics, George Soros opined in his recent book: "On a deeper level, the demise of Lehman Brothers conclusively falsifies the efficient market hypothesis" (2009, 165). The EMH is also central to the accounts of those who consider the soul-searching exercise in economics as an overreaction. John Cochrane of the University of Chicago starts his response to Paul Krugman by vehemently defending the EMH: "no academic, bureaucrat or regulator will ever be able to fully explain market price movements. (…) If anyone could tell what the price of tomatoes should be, let alone the price of Microsoft stock, communism would have worked" (2009, 3). Even Robert Lucas, the author of the rational expectations hypothesis, focused his defense of the dismal science on the EMH (2009).

The third recurring theme is hope. Here behavioral finance (BF) is widely regarded as a beacon of progress in economics – and, in particular, as a major response to modern financial theory, including the EMH (Bernstein 2007). In Krugman's (2009) words: "What's probably going to happen now – in fact, it's already happening – is that flaws-and-frictions economics will move from the periphery of economic analysis to its center. There is already a fairly well developed example of this kind of economics I have in mind: the school of thought known as behavioral finance". BF is credited with opening up economics to insights from psychology, making it more sensitive to the issues of non-rationality and economic instability. "Practitioners of this approach emphasise two things. First, many real-world investors bear little resemblance to the cool calculators of efficient-market theory: they're all too subject to herd behavior, to bouts of irrational exuberance and unwarranted panic. Second, even those who try to base their decisions on cool calculation often find that they can't, that problems of trust, credibility and limited collateral force them to run with the herd" (Krugman, 2009). To be sure, the defenders of the EMH consider BF to be merely a source of exceptions and anomalies from the EMH. According to Lucas, "for the purposes of macroeconomic analysis and forecasting these departures are too small to matter" (2009; see also Ball 2009).

The EMH-BF then, can be conceived as a central blame-hope axis of the debate. It has taken on a strong geographic dimension through the use of anecdotal geographical framing of the debate as a divide between freshwater and saltwater

universities, with the University of Chicago as the intellectual heartland of freshwater economics. The objective of this paper is to put this anecdotal geography to an empirical test, asking: Are the EMH and BF rooted respectively in freshwater and saltwater centres of thought? To address this question we use a citation analysis based on three seminal (most-cited) papers on the EMH, and three seminal papers on BF. Mapping the roots of both schools of thought and their spatial development over time also gives us an opportunity to assess the relative influence of the EMH and BF. Thus, not only can we interrogate Krugman's claim on the lack of convergence between freshwater and saltwater economics, but we can also shed light on the state of play between EMH and BF, questioning the status of the latter as a beacon of hope for the future of economics.

We use citation analysis as a method that provides a valuable perspective on the evolution of an academic discipline or a particular academic debate (Whitehand 1985; Wrigley, Bodman and Whitehand 2002). The selected seminal papers on the EMH and BF constitute citation classics that represent the broader relationship between the EMH and BF (Wrigley 1985; Wrigley and Matthews 1986). The analysis focuses on the affiliations of the authors citing the seminal papers (Foster et al. 2007; Bodman 2010), which are analysed by institution, country, and by region within the USA over time, starting from 1965, when the oldest of the seminal papers was published, until the end of 2010, the last full year for which data are available. The dynamic analysis helps us identify patterns of diffusion and changes in the influence of the EMH and BF. In addition, we account for the geography of collaborations on papers citing the seminal work, as well as the concentration of citing articles by journal and by discipline (Bodman 1991). Finally, we also consider the role of non-university authors citing the seminal papers. The quantitative citation analysis is complemented with insights from the intellectual histories of EMH, BF, as well as finance and economics in general (including Bernstein 2005 and 2007; MacKenzie 2008; and Lo 2007).

While histories of economic thought abound, very few studies have explicitly focused on the role of geography in shaping economic ideas. A study by Terviö (2011) finds that top-ranked American economics departments are indeed divided between freshwater and saltwater 'clusters', which show a discernable tendency to hire new faculty from within the same cluster. Moreover, this dynamic has changed little since the 1980s – and economics appears to be unique in this clustering effect. On the other hand, Coyle (2006) notes that while there was a clear ontological divide in mainstream economics up to the early to mid-1980s, there has been much more intellectual diversity since, in large part due to the use of the Internet in scholarly collaboration. Indeed, there appears to be a broad consensus that the single greatest factor in diminishing the importance of geography in shaping mainstream economic thought is the rise of computing power and cheap communications, particularly the Internet (Rosenblat and Mobius 2004; Kim et al. 2006). While there is a disagreement on the degree of convergence between freshwater and saltwater, to the best of our knowledge no one has yet applied a geographical analysis to investigate the relationship between the EMH and BF.

Our results show that the simple geographic distinction between freshwater and saltwater economics does not apply to the EMH and BF. While the roots of the EMH are obviously in the University of Chicago, saltwater economists from the very beginning heavily cited the seminal EMH papers. BF has mixed roots, and its seminal papers have been cited across the USA. In addition, there is much freshwater-saltwater collaboration on articles citing both the EMH and BF. In short, freshwater economists seem to have been receptive to the ideas of BF from its very inception. In contrast to Krugman's claim (2009), convergence seems to have been almost instant. However, the popularity of BF lags behind the EMH in terms of the quantity and scope of citations: BF citations are much fewer in number and are not increasing at a higher rate than those for the EMH. They are also more concentrated in terms of journals and subject areas, and have less following outside the USA. The jury is still out, as BF is much younger than the EMH. Our results however cast doubts on the power of BF as a constructive alternative to the EMH, with the latter still used as a benchmark. With the freshwater-saltwater myth debunked, and doubts about the relative force of BF, we extend Hall's lexicon and propose the term 'deepwater economics' to refer to economic thought with origins outside the USA. We suggest that the US-deepwater divide may be more salient than that between freshwater and saltwater. The attention of those concerned about the future of economics should focus on intensified dialogue between the US economics and that practiced abroad, particularly in various fields of heterodox economics.

Efficient market hypothesis and behavioral finance in context

Before delving into our citation analysis, we need to justify our choice of the seminal papers and outline their respective contributions to economics. With regard to the EMH, some may be surprised by its prominence in the debate on the state of economics. In contrast to the EMH, other ideas of modern financial theory, from Markowitz's theory of portfolio selection, through Sharpe's Capital Asset Pricing Model, Miller's and Modigliani's theory of capital structure, to option pricing by Merton, Scholes, and Black have earned their authors Nobel prizes (MacKenzie 2008). It is ironic that EMH became the symbol of inventions that have claimed more formal accolade, but this is probably because it is less technical and showcases the idea of market efficiency, capturing the spirit of the Chicago School once defined by Milton Friedman as "a belief in the efficacy of the free market as a means of organizing resources and skepticism about government intervention into economic affairs" (cited in Lippert 2008).

According to Lo (2007), the EMH was developed independently by Paul Samuelson and Eugene Fama. However, it was Fama who first used the term 'efficient markets', wrote dozens of papers on the topic, popularized it through a classic textbook, *Theory of Finance* (co-authored with Merton Miller), and developed methodologies to test market efficiency. We use three papers by Fama as seminal EMH articles: the 1965 paper that first used the term 'efficient market' for securities; 1970 paper that formally develops the EMH; and a 1991 sequel to the 1970 paper, which also serves as a response to BF. The 1970 paper is no. 20

on the list of the most cited papers in economics published since 1970 (Kim et al. 2006).

For BF, we have selected 3 most cited papers (according to Web of Science) from a list of landmark papers identified in two major reviews of the EMH and BF (Lo 2007; Sewell 2011). To be sure, not all critiques of the EMH qualify as BF. For this reason we have not included a famous (and heavily cited) paper by Grossman and Stiglitz (1980) on the impossibility of informationally efficient markets, as it does not focus on individual behavior and its influence on market behavior. Nor do we use Kahneman and Tversky's (1979) classic on decision making under risk, which surely inspired much of BF. The latter has a much broader scope and hardly mentions finance. By confining BF within the study of finance, we ensure that as fair a comparison as possible can be made with the EMH. Needless to say, the EMH-BF axis is a part of a much larger debate between neoclassical economics, with its assumptions of rationality, and more Keynesian and behavioral approaches which are concerned with the systemic consequences of non-rationality (Findlay and Williams 2000, 1).

Let us outline the contribution of each paper to the field of financial economics in chronological order. Fama's 1965 paper in the *Journal of Business* comprised his entire PhD thesis. His immediate influence on practitioners is underscored by the fact that later that year a simplified version was also published in the *Financial Analysts' Journal* and reprinted in *Institutional Investor* in 1968 (Bernstein 2005). The paper asks: "To what extent can the past history of a common stock's price be used to make meaningful predictions concerning the future price of the stock?" (34). Through empirical analysis, Fama demonstrates that successive price changes are independent, confirming the theory of random walks in stock prices, and refuting the claims of chartists, who considered past behavior of a security's price rich in information concerning its future behavior. Fama admits that uncertainty concerning intrinsic values of securities generates 'noise' trading, which in turn could produce bubbles. However, sophisticated traders, who try to predict new information and assess its impact on intrinsic values, would burst the bubbles before they even had a chance to develop. The economic implication is that actual prices are at every point in time very good estimates of intrinsic values, thus making the market efficient. An analysis of mutual fund performance at the end of the paper shows that they are not able to consistently outperform average returns from the market, indicating that sophisticated investors are difficult to detect, which lends additional support for the random walk theory and market efficiency.

In 1969 the American Finance Association invited Fama to present a full review of the theory of efficient markets and related empirical work, leading to his 1970 paper published in the *Journal of Finance* (Bernstein 2005). The paper famously defines an efficient market as one in which 'prices always fully reflect available information'. The main contribution of the paper is to distinguish between three types of information. A market passes a weak form test of efficiency if prices current prices fully reflect historical prices; a semi-strong form test if they fully reflect other publicly available information (e.g. announcements of profits or stock splits); and a strong test if they fully reflect relevant private information. A review of empirical evidence presented in the paper leads to the conclusion that

there is no important evidence against the hypothesis in the weak and semi-strong form, and only limited evidence against the hypothesis in the strong form. As the paper reports, access to private information has only been documented for corporate insiders and NYSE specialists trading stocks, and this type of information does not seem to "permeate down any further through the investment community" (416).

Our story of the three seminal papers in BF starts with Robert Shiller's 1981 paper in the *American Economic Review*, the most cited early paper highlighting a major problem with the EMH. This paper compares stock price changes to subsequent changes in dividends. The assumption made is that dividends are the fundamental factor affecting stock prices, according to the model that "the real stock price equals the present value of rationally expected or optimally forecasted future real dividends discounted by a constant real discount rate" (421). Using data for the period of 1871 to 1979, the paper shows that stock prices move far too much to be justified by subsequent changes in dividends. In other words, stock market behaves like a weatherman who commonly forecasts 150 degrees for a warm day and -50 for a cold day. If prices fully reflected all available information, we would expect variability in stock prices to be less or at least not significantly greater than the variability in underlying fundamentals (Bernstein 2007). Shiller concludes that "the failure of the efficient markets model is thus so dramatic that it would seem impossible to attribute the failure to such things as data errors, price index problems, or changes in tax laws" (434).

De Bondt and Thaler (1985) build on Shiller's insights, but try to link the psychology of investors and market behavior explicitly, using insights from Kahneman and Tversky. Their *Journal of Finance* paper focuses on the behavioral phenomenon of overreaction to recent information, leading to systematic overshooting of price changes followed by price reversals. They formulate two hypotheses: "(1) Extreme movements in stock prices will be followed by subsequent price movements in the opposite direction. (2) The more extreme the initial price movement, the greater will be the subsequent adjustment" (795). Analysis based on data for 1926-82 confirms both hypotheses, and represents a major violation of weak-form market efficiency. If overreaction is systematic, then past prices do contain information that can be used to predict future prices.

DeLong, Shleifer, Summers and Waldmann (1990) attack the part of Fama's EMH which ignores the systemic role of noise traders (unsophisticated or irrational traders) on the assumption that they are met in the market by rational arbitrageurs who trade against them and drive prices close to fundamentals. Their *Journal of Political Economy* paper points out that the EMH ignores noise trader risk, whereby arbitrageurs trading against noise traders have limited resources and may have to liquidate their positions before the price reverts towards its intrinsic value. The paper offers a model that shows that arbitrage indeed does not eliminate the effects of noise, with the noise trader risk reducing the attractiveness of arbitrage, and the self-correcting power of the market: "noise trading can lead to a large divergence between market prices and fundamental values" (735). The paper also helps to explain why many professional arbitrageurs spend considerable resources examining the pseudo-signals followed by noise traders or reflecting their behavior, such as past

volume and price patterns or investor sentiment indices. Thus, when noise trader risk is considered, even the chartism condemned by Fama in 1965 appears useful.

Finally, Fama (1991) offers an updated review of literature on the EMH, and a response to its critics, in the *Journal of Finance*. While he admits that the extreme version of the EMH surely does not hold in reality, he maintains that it represents a clean benchmark against which to measure the efficiency of price adjustments to different types of information. The paper stresses the joint hypothesis problem of testing market efficiency. To test whether prices 'fully' reflect information, we need to use a model of asset pricing telling us what a 'full reflection' means (e.g. CAPM). Only then can we establish how efficient the adjustment of actual prices to model prices is when new information arrives on the market. In consequence, anomalies in the EMH can be blamed on either inefficiency or an inadequate model of asset pricing, with proportions of blame impossible to specify. The paper questions the contribution of behavioral finance on the grounds of the joint hypothesis problem as well as issues with data used in BF. In Fama's view, the cleanest studies of market efficiency are event studies, which actually show that on average stock adjust very quickly to new information, thus supporting at least the semi-strong version of the EMH.

While all of these six papers may seem narrowly technical, their influence has been widely felt in academe and beyond. The EMH, in particular, contributed to a transformation of both financial theory and practice. It was born as a heterodox challenge to the value of descriptive finance, dominant since before the WWII; yet within an astonishingly brief span of time (aided, of course, by advances in computing power and the use of large datasets in the 1970s), gave rise to the dynamic field of financial economics. While the EMH glorified the market, it started its career by antagonizing finance practitioners, unaccustomed to 'scientific' methods of managing returns and risks. With time, however, it helped to transform the industry with the rise of passive investment strategies, including international diversification, investment performance evaluation, use of mathematical models in risk management, and regulatory focus on disclosure as a means of promoting efficient markets (Bernstein 2005; MacKenzie 2008).

As an attack on the EMH, BF thus challenges a whole intellectual edifice, which also underpins a body of financial practices. To be sure, many departures from the EMH are highlighted by BF other than those elaborated in the selected seminal papers, including herding, loss aversion, hyperbolic discounting, regret, and overconfidence (Shleifer 2000; Lo 2007). At the height of the EMH's influence, Michael Jensen, a student of Fama, wrote, "I believe there is no other proposition in economics which has more solid empirical evidence supporting it than the EMH" (1978, 95). BF has undoubtedly dented confidence in this solidity, but even its fiercest critics are far from abandoning it. The EMH is simply "one of the most hotly contested propositions in all the social sciences" (Lo 2007, 1). This paper maps this contest and its geography.

Data and methods

We use Web of Science, the online database, as a source of data on articles (referred to also as papers) citing the six seminal EMH and BF works outlined above. Our sample of citing papers includes only academic journal articles; it excludes citations in books, book chapters, book reviews, editorial materials, conference proceedings, and any other media. For each paper our data extends from the year of publication to the end of 2010. The exclusive focus on journal articles reflects the fact that in economics publications in academic journals are by far the dominant currency in the exchange of ideas. In contrast to other social sciences, citation analyses in economics usually do not refer to media other than papers (e.g. Kim et al. 2006). Self-citations, e.g. articles by Fama citing one of his own seminal papers, are included, as our emphasis is on comparing the influence of the seminal papers, not on comparing the influence of authors. In any case, the share of self-citations does not exceed 2% of all citations for any of the papers, so they do not distort the analysis. For each citing article we have data for all authors, their affiliations and addresses, journal name, subject area of the journal, and year of publication. Each citing article is assigned to the primary affiliation of the reprint/lead author.

In tallying the frequency of affiliations for US institutions, we required a rigorous definition of saltwater and freshwater which was missing in existing literature. Our definitions are as follows. A saltwater institution on the east coast is any institution that falls within 100 miles of the Atlantic seaboard, from Maine to Florida. For the west coast, we included any institution in the states of Washington, Oregon, and California. Determining what can be considered a freshwater institution is less straightforward. Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York border the Great Lakes and form the traditional collection of Great Lakes states. However, New York City and Philadelphia cannot be said to draw their regional customs or cultural influence from their proximity to the Great Lakes as much as, say, cities in Vermont, New Hampshire, or Iowa, which do not border the Great Lakes. In order to capture the fuller geographical reach and home of the freshwater schools, then, we drew a parallel line extending 300 miles from the coast of the Great Lakes. The area between the coast of the Great Lakes and the 300 mile boundary incorporates several additional States, such as the northernmost portions of Kentucky, West Virginia, and Maryland, as well as Iowa, New Hampshire, and Vermont. Neither Kentucky, West Virginia, nor Maryland despite their proximity to the Great Lakes are generally considered as part of the Great Lakes region or as freshwater centers. Institutions in these two States then are not considered as freshwater. Accordingly, a freshwater designation must meet three criteria. First, the institution is located in one of the following States: Minnesota, Wisconsin, Iowa, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York, Vermont, and New Hampshire. Second, it falls within 300 miles of the shores of the Great Lakes. And finally, it does not fall within 100 miles of the Atlantic seaboard. Those US institutions that did not qualify as freshwater or saltwater were grouped as "All Other." The estimated population of east coast, west coast, freshwater, and other US, as defined above, is 90 m, 50 m, 50m, and 120 m respectively. Their map is presented in figure 1.

[Insert figure 1 around here]

When considering papers with more than one author, we restricted our analysis to articles with only two authors in order to capture as neatly as possible the incidence of inter-regional academic work. By isolating just two authors, we avoid the problem of many permutations of possible collaborations. In any case, articles with two authors represent the majority of articles with more than one author. An article with authors from either the east or west coast is considered a saltwater collaboration - with the same applied to two freshwater authors - while one author from either the east or west coast and one author from a freshwater university is considered a salt- and freshwater collaboration. Articles with authors from an "All Other" institution were not counted for the purposes of analyzing collaborations.

To the best of our knowledge, this is the first paper that uses a citation analysis to investigate the relationship between EMH and BF. The type of citation analysis we use is basic, but our intended contribution lies in its application to a new and important topic. We acknowledge limitations inherent in our method, including the ignorance of the quality and nature of citations. However, we believe that even in its basic form citation analysis serves as a good general indicator of influence (Wrigley, Bodman, Whitehand, 2002). In the following empirical sections we use citation analysis combined with histories of EMH and BF, to explore the geography of each of these approaches, before moving on to assessing their relative influence.

Geography of the EMH

Fama's lifetime affiliation with University of Chicago contributes to the rise of the EMH to the status of a symbolic product of the Chicago School. The literature suggests a number of factors to explain why Chicago University was a fertile ground for the EMH (Bernstein 2005; MacKenzie 2008). Of course, Milton Friedman was based at Chicago for 30 years, beginning in 1946. The Chicago economics department also hosted the world-famous Koopmans's Cowles Commission for Research in Economics (which employed Harry Markowitz, among others) between 1939 and 1955. Also crucial was a commitment to empirical and applied research, manifested in the close ties between the economics department and the business school. This was atypical: "At most universities, the business school and economics faculty barely greeted each other on the street. (…) At Chicago, however, and later MIT and a few other universities, the two faculties cooperated closely" (Bernstein 2005, 46). It was the University of Chicago Graduate School of Business (GSB) which hosted the Center for Research in Security Prices (CRSP), founded in 1960 by James Lorie and Lawrence Fisher with a grant from Merrill Lynch, Pearce, Fenner & Smith, Inc. CRSP funded research, seminars, and conferences, and provided the first computerized dataset on stock prices going back to 1920s – the main dataset with which EMH and other financial theories of the time were tested.

Fama epitomized the creative spirit of this environment. He earned an MBA in 1963 and his PhD in 1964 at the GSB, under the supervision of Merton Miller and

Harry Roberts, and championed the use of CRSP data. He later remarked of his early years at Chicago, "We were like kids in a candy store" (interview with Bernstein 2005, 107). Fama never left the University of Chicago, and GSB was renamed University of Chicago Booth School of Business in 2008, following a $300m gift from David Booth, a former student of Fama, and founder of Dimensional Fund Advisors, on which Fama served as a director.

The only other institution which has made a contribution to modern financial theory in any way comparable to that of Chicago was the Massachusetts Institute of Technology (MIT). In fact, MacKenzie (2008, 73) uses the term 'the Chicago-MIT axis' to reflect the close links and outsized influence of these twin centres of efficient-market thought. In 1960s MIT's research on EMH was initiated by Samuelson's theoretical work and Paul Cootner's research. Particularly important was Cootner's 500-page book *The Random Character of Stock Prices*, which included a chapter by Fama (Bernstein 2005). The axis is also embodied in the working relationship between the Nobel Prize-winning duo of Merton Miller and Franco Modigliani, who developed their theory of capital structure from the University of Chicago and MIT, respectively. The trio behind the options pricing model also straddled the axis. Fischer Black worked at Chicago from 1971 to 1975 when he left for MIT. Myron Scholes, having completed his PhD in Chicago in 1969, supervised by Fama and Miller, took a position at MIT. Robert Merton, a student of Samuelson, spent his career at MIT. Indeed, this example might even suggest a shift of influence – or at least a partial surrender of an exclusive intellectual monopoly – from Chicago to MIT in the 1970s.

Citation analysis for EMH papers complements qualitative accounts of the history of the idea. Figure 2 reminds us that Chicago and MIT constitute just a drop in the bucket of EMH citations, highlighting the wide influence of the EMH. Overall, Chicago dominates, with MIT not even in the top five institutions citing any of Fama's papers. In fact, authors from the University of Pennsylvania have cited EMH papers nearly twice as many times as those from MIT. Over time, as we move from the 1965 to the 1991 paper, the share of Chicago's citations of the EMH melts down (figure 2). While Chicago by far leads the EMH citation tables for the first two papers, for the last paper it is not even among the top five institutions. In short, it appears that MIT has never led the interest in EMH outside of Chicago, and that Chicago itself has long moved on. Thus the use of the term 'Chicago-MIT axis' appears unjustified.

[Insert figure 2 around here]

The regional patterns of EMH citations are rather similar between the three papers, and are presented in aggregate in figure 3. While there are no strong trends, the share of freshwater seems to fall, and that of other US institutions seems to grow over time. This might be explained by a diffusion of EMH from Chicago and other freshwater universities, including freshwater PhD students taking up university positions around the country. However, there are a lot of saltwater citations of EMH throughout the period, suggesting that saltwater universities were receptive to the EMH from the very beginning, and the EMH never even needed to 'colonise' coastal universities. Perhaps by late 1960

Chicago School ideas were already well established beyond the Great Lakes region.

[Insert figure 3 around here]

Of course, it is possible that the majority of saltwater citations are critical of EMH. We are unable to control for it, as it would require a content analysis of every individual paper. In other words, we can refer to saltwater (and any other) citations of the EMH as instances of engagement with or use of EMH, not as agreement with the EMH. However, we have further evidence that corroborates our findings suggesting the lack of animosity to the EMH on the part of saltwater institutions. Figure 4 shows that papers citing the EMH and co-authored across the freshwater-saltwater divide were common and present from the very birth of the EMH. In summary, while citation analysis confirms the central role of Chicago, it does not confirm the significance of a Chicago-MIT axis, and questions the significance of the purported freshwater-saltwater divide with regard to the EMH.

[Insert figure 4 around here]

Geography of behavioral finance

In contrast to the EMH, no books devoted to the history of behavioral finance have yet been written. We therefore start by summarizing the geographical roots of BF, based on the affiliations of the authors of seminal papers, in table 1.

[Insert table 1 around here]

The geographical roots of BF are mixed. Shiller completed his PhD at MIT supervised by Franco Modigliani, and has taught at Yale since 1982, working also as an associate of the Cowles Foundation, which moved from Chicago in 1955. His first postdoctoral position however, was at the University of Minnesota (Campbell, 2006). De Bondt and Thaler wrote their paper while the former was a PhD student of the latter at Cornell University. Both now teach in Chicago, and Thaler's office is actually around the corner from Fama's (Cassidy 2010). The latest paper in our selection was written under the mentorship of Summers from Harvard, with both De Long and Waldmann at Harvard as well, but one of the co-authors Andrei Shleifer, worked in Chicago at the time of writing the paper, where he also co-authored papers with Richard Thaler. Thus, while of the three seminal BF papers, two can be described as products of saltwater and one as a product of freshwater universities, there are traces of freshwater in the origins of the two predominantly saltwater papers as well.

Citation analysis confirms the significance of freshwater institutions to the diffusion of BF. While Harvard is the leading source of citations for all three seminal BF papers, Chicago is ranked third for each of them. Regional citation patterns aggregated for all BF papers in figure 5 show a significant share of freshwater universities (17.5% overall compared to 14.5% for EMH papers) from the beginning. It would therefore appear that no diffusion was really needed between freshwater and saltwater in the case of BF. The share of other

US institutions does not seem to increase over time, in contrast to EMH papers (figure 3). Indeed, a comparison between figures 2 and 5 suggests that BF ideas have not influenced 'Al Other' US nearly as much as EMH. Patterns differ between individual papers. While unsurprisingly the share of freshwater citations is the highest for De Bondt and Thaler (1985), it is lowest for De Long et al. (1990), for which other US universities are the main source of citations.

[Insert figure 5 around here]

Results on coauthored papers are similar as those for EMH papers (figure 6). Freshwater-saltwater collaborations, though small in absolute numbers, occur from the very beginnings of BF in 1980s. Overall the saltwater-freshwater divide does not seem to have ever played an important part with regard to BF. The roots of BF include freshwater institutions and its ideas have been cited heavily in freshwater schools from their very inception.

[Insert figure 6 around here]

Relative influence of EMH and BF

Citation analysis offers an insight into the relative influence of the EMH and BF. Figure 7 presents aggregate number of citations by year. In total EMH papers had been cited 3184 times by the end of 2010 (1068 for the 1965, 1564 for the 1970, 552 for the 1991 paper); and BF papers 1690 times (597 for the 1981, 548 for the 1985, 545 for the 1990 paper). The EMH papers have a total age of 104 years compared to 74 years for BF, giving an average number of citations per year of 31 for EMH versus 23 for BF. While this might still be explained partly by a shorter history of BF, it is noteworthy that EMH citations significantly outnumber BF citations in every single year, and that EMH citations have recently grown at a higher rate than those of BF. Between 2001 and 2010 EMH citations grew by 170% (68% for the 1965, 369% for the 1970, 109% for the 1991 paper) while BF by 59% (45% for the 1981, 70% for the 1985, 58% for the 1990 paper). As figure 7 shows, the dynamics of BF citations has fallen behind those of the EMH since 2008. The total number of EMH citations for the years 2004-6 exceeds those in 2001-3 by 24%, while the corresponding growth rate for BF is 27%. The total number of EMH citations for the years 2009-10 exceeds those in 2007-8 by 48%, while the corresponding figure for BF is only 15%. This is mixed evidence for the relative power of BF. On the one hand, we could speculate that the EMH has been particularly heavily cited in the wake of the global financial crisis, mainly because it has been criticized. On the other hand, citing authors do not seem to embrace BF as an alternative, and even for the years preceding the crisis BF citations had only matched rather than outpaced those of the EMH.

[Insert figure 7 around here]

In addition to their strength in numbers and rate of growth, EMH citations are spread more widely than BF across subject areas and journals. The home subject area of all the six papers is business and economics (as defined by Web of

Science), but while for EMH papers it accounts for 68%-82% of citations; for BF papers the range is 92%-93% (figure 8). The only other subject areas with a 3% or larger share of BF citations are operations research and mathematics. For EMH papers such areas include also computer science, government and law, and physics. For each of the six papers, the *Journal of Finance* leads among the host of citations; for EMH papers its share ranges from 3.7% to 5.8%, for BF from 5.9% to 11.9%. The concentration of citations in the top five journals (specific to each paper) for EMH papers ranges from 14% to 19%, for BF papers from 21% to 33% (figure 9). The share of citations by authors with non-university affiliations is 6% for EMH and 7% for BF papers.

[Insert figure 8 around here]

[Insert figure 9 around here]

Figure 10 shows a strong trend of internationalization of citations. For the EMH this has accelerated since mid 1990s. For BF intensive internationalization took place in the late 1980s and early 1990s, then slowed down in late 1990s and early 2000s, to pick up again in late 2000s. There has clearly been a diffusion of EMH and BF ideas from the USA to the rest of the world. Since the mid 2000s foreign citations outnumber US citations for each of the six papers. EMH citations, however, are more internationalized than BF citations in terms of stocks as well as flows. The share of foreign citations (in the total stock of citations) for EMH papers ranges from 42% to 44%; for BF it is 31% to 36%. Since 2002 the share of foreign citations of BF has lagged behind the EMH by 10 to 20 percentage points. In addition, BF papers appear less popular in non-English-speaking countries. The share of the UK, Canada and Australia in foreign citations for EMH papers ranges from 39% to 50%, for BF from 41% to 57%.

[Insert figure 10 around here]

All dimensions of the citation analysis thus indicate the continued relative strength of the EMH. Perhaps, then, we need to throw cold water on Krugman's faith in BF as a response to EMH, and agree with Bernstein's (2007, xix) conclusion that "despite its rigid assumptions about investor rationality and the role of information, the Efficient Market Hypothesis remains the standard by which we judge market behavior and manager performance". BF may be a direct attack of the EMH, but it may lack power as an alternative. As Andrew Lo put it, "you need a theory to beat a theory" (cited in Bernstein 2007, 61). Ironically, his Adaptive Market Hypothesis, the leading theoretical proposition presented as a fully-fledged alternative to EMH, published in 2004, according to Web of Science has only generated 36 article citations by late 2011. There is also a degree of acceptance of the EMH within BF. De Bondt et al. (2008, 1) see room for convergence between the two ideas: "the behavioral element is central to the new proposition without disputing the value of the traditional approach", and "the new paradigm will combine the best of neoclassical and behavioral elements".

Conclusions and implications

Our objective was to shed light on two issues which have been prominent in the ongoing soul-searching exercise in economics in the wake of the global financial crisis: the significance of the freshwater-saltwater division within US economics, and the relative power of behavioral finance as a potential successor to the efficient market hypothesis. We have investigated both issues through a citation analysis of six seminal papers on the EMH and BF. The analysis shows that while the EMH had predominantly freshwater and BF mainly saltwater roots, both ideas permeated universities across the division almost instantaneously. Thus, anecdotal evidence of a saltwater-freshwater divide does not seem to reflect reality. It may rather be interpreted as an attempt to link contemporary US economics to the popular perception of the political division between liberal, Democratic-leaning coastal areas and the more conservative, Republican-leaning rest of the country. The University of Chicago, in particular, is one of the centres of BF. Richard Posner (cited in Cassidy 2010) suggests that "probably the term 'Chicago School' should be retired". Historically, the influence of the Chicago School cannot be denied: as our results help to demonstrate, it spreads across the USA and internationally. However, our results indicate that as much so-called 'freshwater' thinking can be found in New York, Boston or California as in Chicago, while BF thought has permeated inland. With reference to the EMH and BF, then, the term 'Chicago School' could indeed be retired.

With regard to the second question, we find BF, 25-30 years after its inauguration, still in a relatively weak position in relation to EMH. Fewer articles cite the seminal BF papers; BF citations grow at a slower rate; they have less influence outside of freshwater and saltwater universities, and less international reach. In addition they have less scope in terms of subject areas and journals. We could agree with Posner declaring that "behavioral finance is on the march" (Cassidy 2010), but we would add that BF is far from stealing the march on the EMH. The relative power of EMH versus BF does not suggest a paradigm change in financial economics. It will probably take much more than BF before any chance of a paradigm shift appears. As Bernstein notes, BF does not account for institutional design (2007, 49). And even if BF is married with an institutional approach (e.g. Merton and Bodie 2005, cited in Bernstein 2007), it may still be far from accounting for the forces of history and geography.

If, as our results suggest, the saltwater-freshwater distinction is unhelpful in diagnosing the ills of economics, and BF is an insufficient cure, where else should we look for underlying problems – and solutions to them? We would suggest one significant direction for further research. Arguably the ongoing debate is centred disproportionately on the US mainstream economics, marginalizing the role of long-established heterodox approaches, including post-Keynesian, feminist and Marxist approaches; economic insights from other social sciences than economics; and non-US economics in general. In contrast to most social sciences, including geography (Bodman 1991; Rodriguez-Pose 2006 cited in Foster et al. 2006, p.298), the world of economics is still very much unipolar, with leading journals edited in the USA, with predominantly US contributors, and more heterodox and interdisciplinary journals operating in the periphery of the system, with mostly non-US base and contributors. It appears that for the most part the flow of economic ideas has been too unidirectional. From their analysis of 146 most cited papers in economics published between 1970 and 2006, Kim

et al. (2006b, 7) find that "eighty-five percent of the most cited papers are written by researchers when they were working at U.S. institutions. This share does not exhibit any decline over time; in fact, it slightly increases in the last five years".

The US versus deepwater divide in economics is illustrated in figure 11 presenting the geography of affiliations for the 3 leading mainstream, US-based journals, and 3 leading heterodox journals, based in Europe. The share of papers with US-based corresponding authors in the 6-year period 2005-2010 ranges from 60% to 70% for orthodox journals, and from 20% to 30% for heterodox journals. While the share of foreign-based authors in orthodox journals increased by 5 to 20 percentage points compared to the 6-year period 1980-1985, the share of US authors in the *Cambridge Journal of Economics* and *Development & Change* actually decreased over the past quarter century. As the heterodox journals are arguably more interdisciplinary in scope, it is a pity to see signs of US scholars disengaging with some of them. According to Shiller and Shiller (2011), the global financial crisis highlights the perils of excessive specialization in economics driven by the dictate of scientific rigor, and calls for more interdisciplinary interaction and broader vision. We could not agree more. As Marion Fourcade (2009) demonstrates, different national institutional structures and processes lead to different types of economic knowledge. It is also in a dialogue between these different types of knowledge that hope for the future of economics must be sought.

[Insert figure 11 around here]

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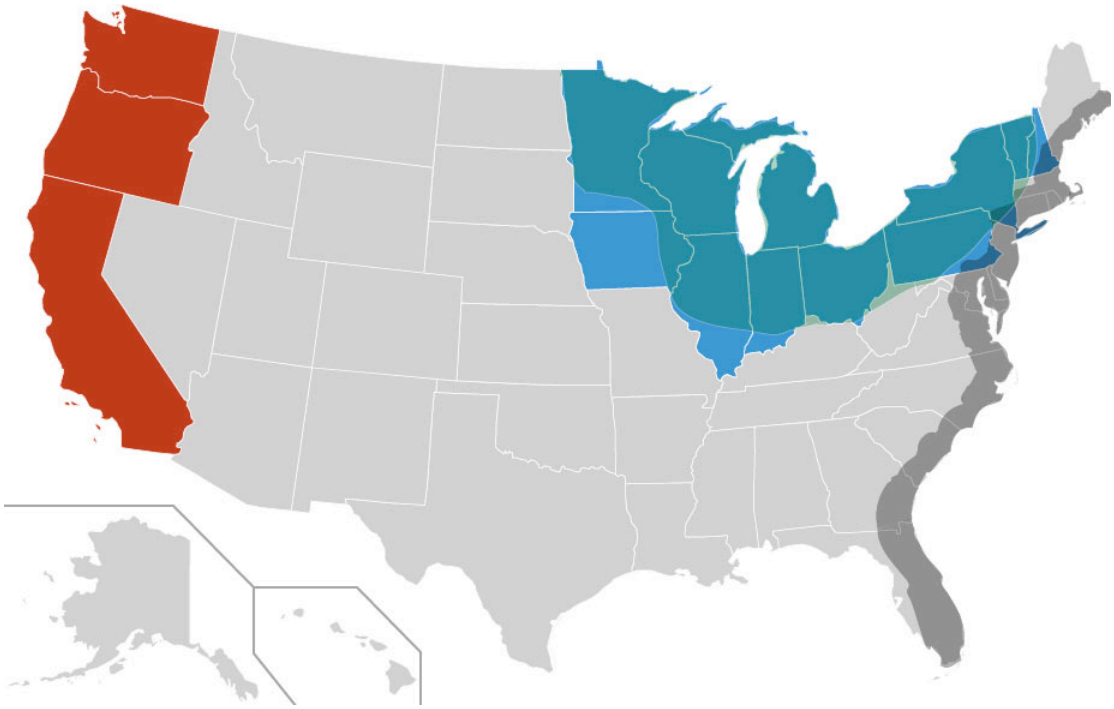
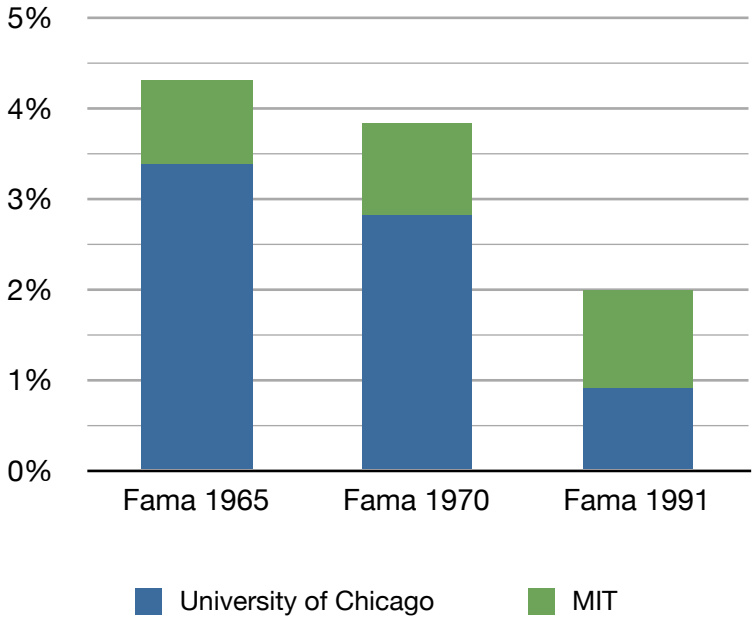
Figure 1. Freshwater and saltwater USA



Note: Red – saltwater west coast; dark grey – saltwater east coast; blue – freshwater states; green – within 300 miles from the Great Lakes; light grey – rest of the country. Source: Own

Figure 2. The share of Chicago and MIT in EMH citations



Source: Own based on data from Web of Science (also for all other figures).

Figure 3. Structure of EMH citations by region

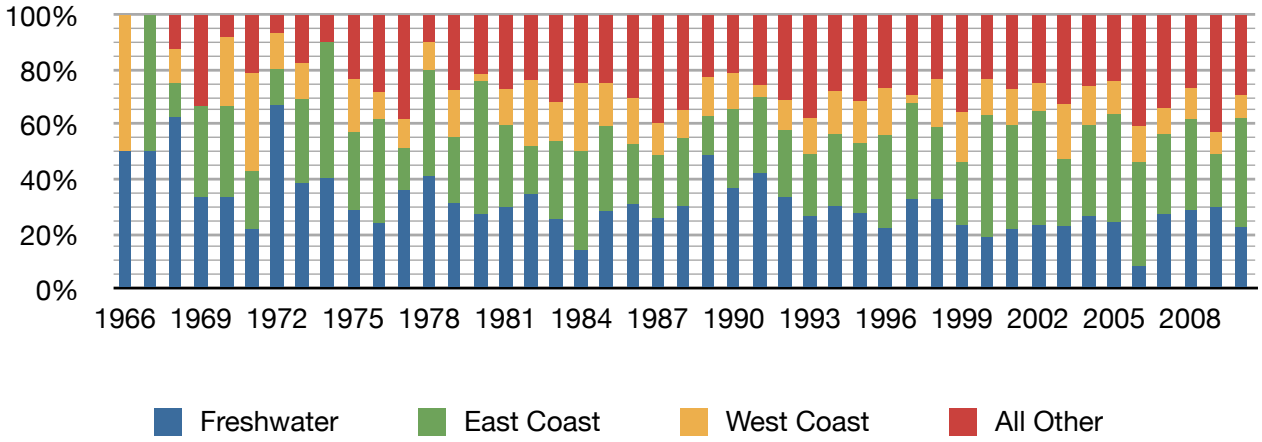


Figure 4. The number and structure of co-authored papers citing EMH

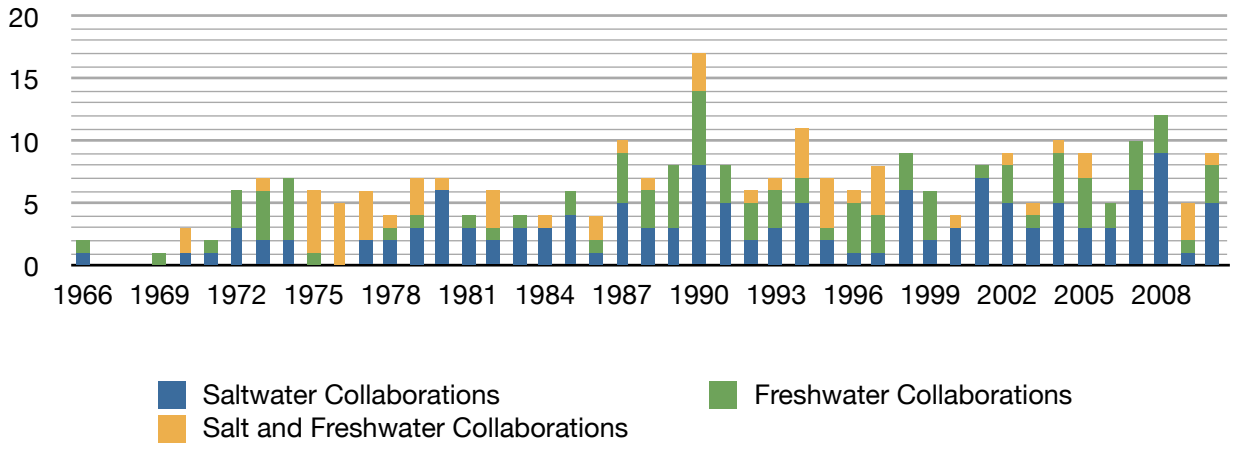


Figure 5. Structure of BF citations by region

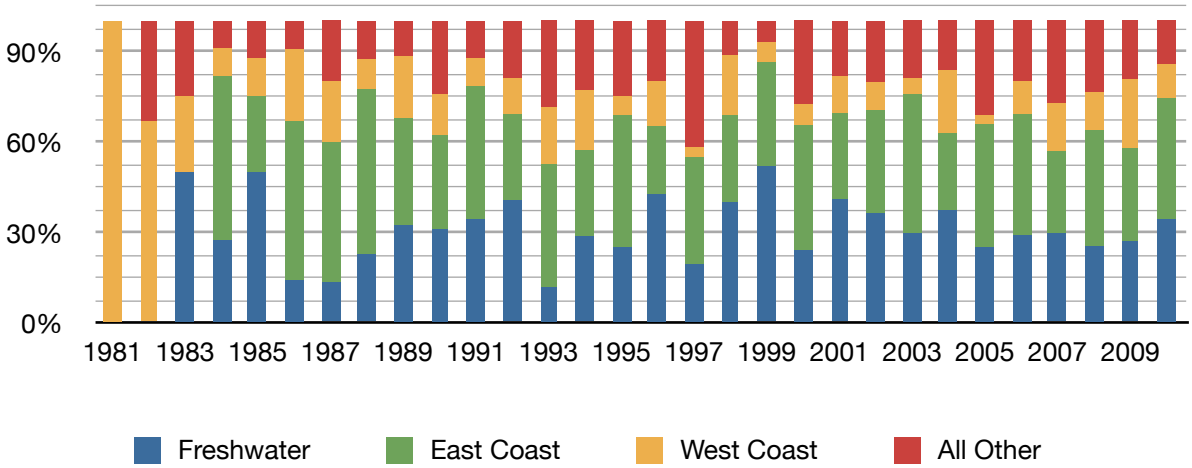


Table 1. Affiliations of BF authors

	Current	Past	PhD
Robert Shiller	Yale	UPenn, Minnesota	MIT
Werner De Bondt	De Paul in Chicago & U. Wisconsin	Cornell U., various universities in Europe	Cornell
Richard Thaler	Chicago Booth School	Cornell U.	Rochester
Bradford De Long	UC Berkeley	Harvard, Boston U., MIT	Harvard
Andrei Shleifer	Harvard	Chicago GSB, Princeton	MIT
Lawrence Summers	Harvard	Brookings, US Treasury	Harvard
Robert Waldmann	University of Rome (Italy)	European University Institute, Bocconi	Harvard

Source: Own compiled from CVs available online.

Figure 6. The number and structure of co-authored papers citing BF

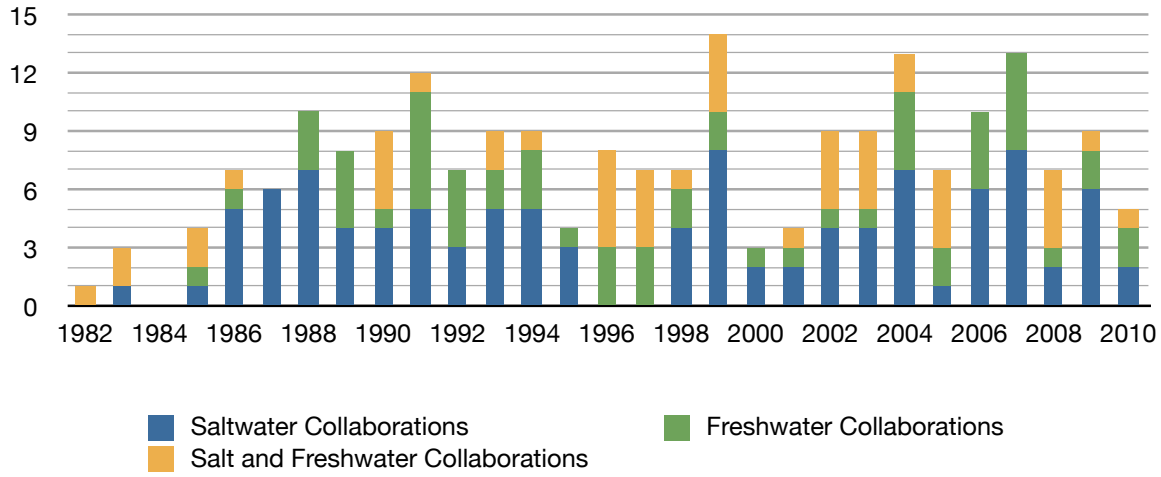


Figure 7. Annual citations of EMH and BF

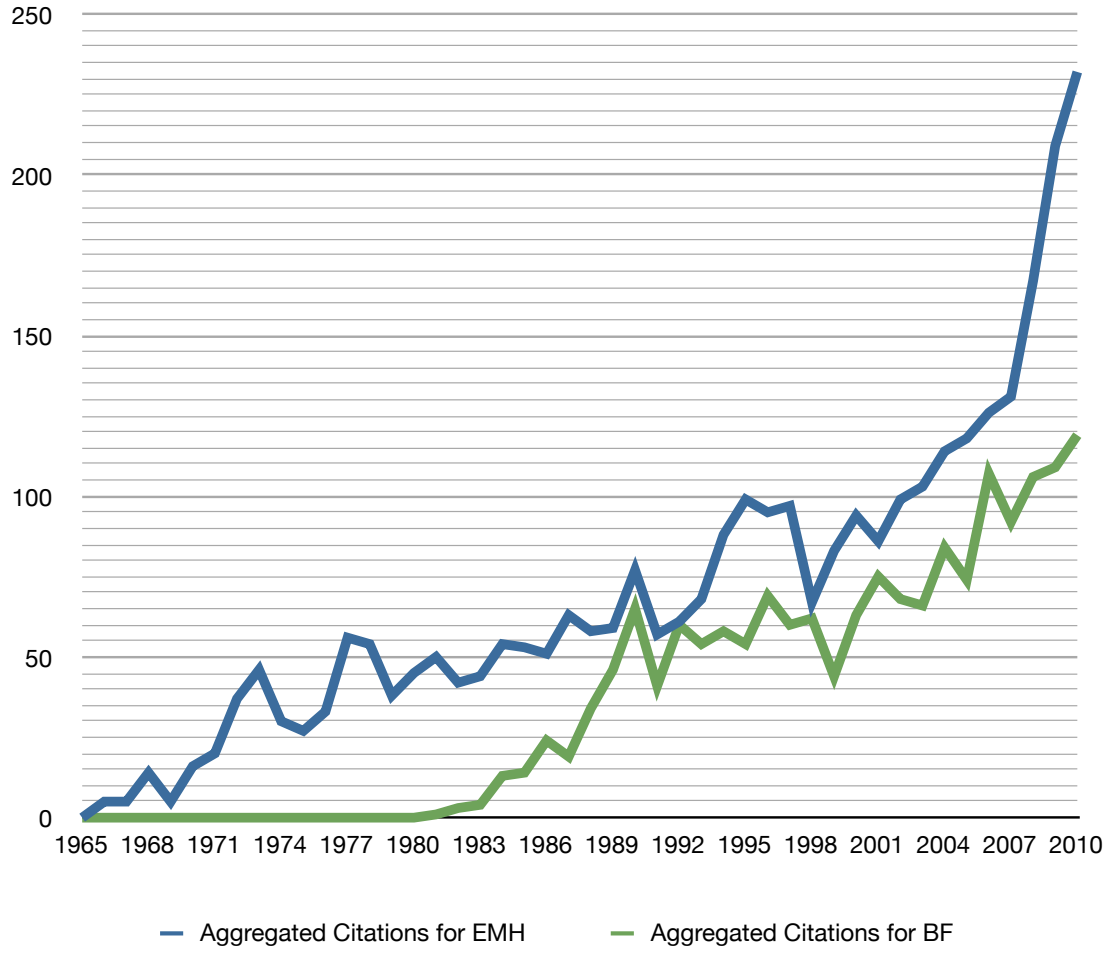


Figure 8. Share of business and economics in total citations

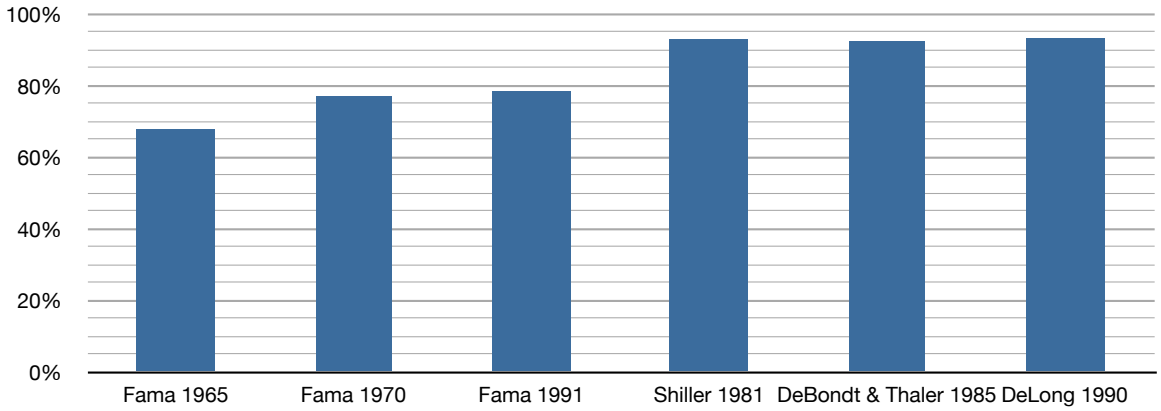


Figure 9. Share of the top five citing journals in total citations

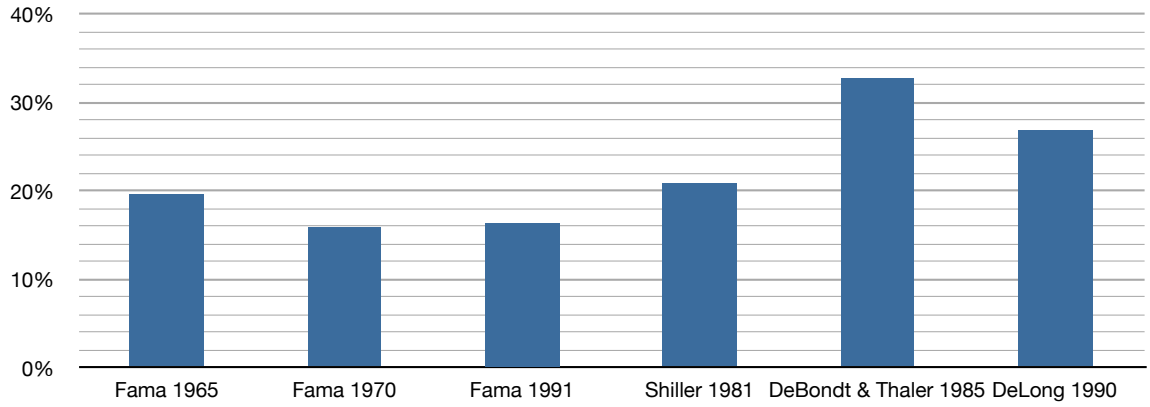


Figure 10. Share of non-US affiliated authors in total citations

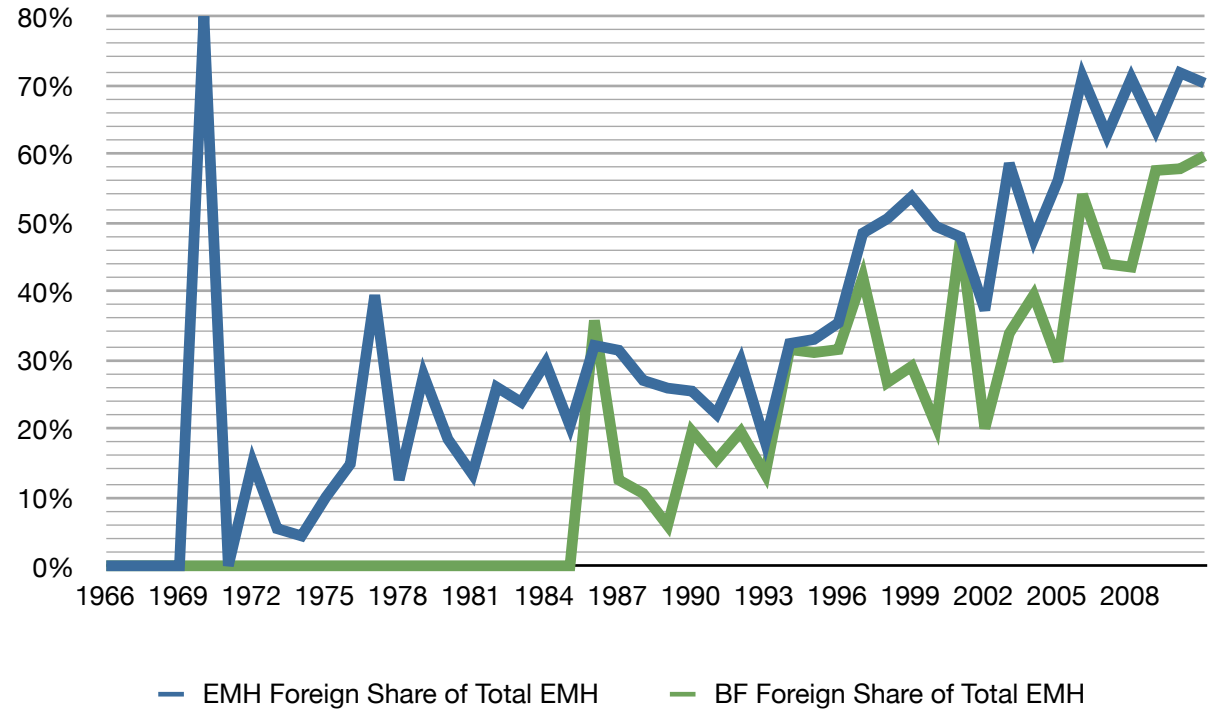
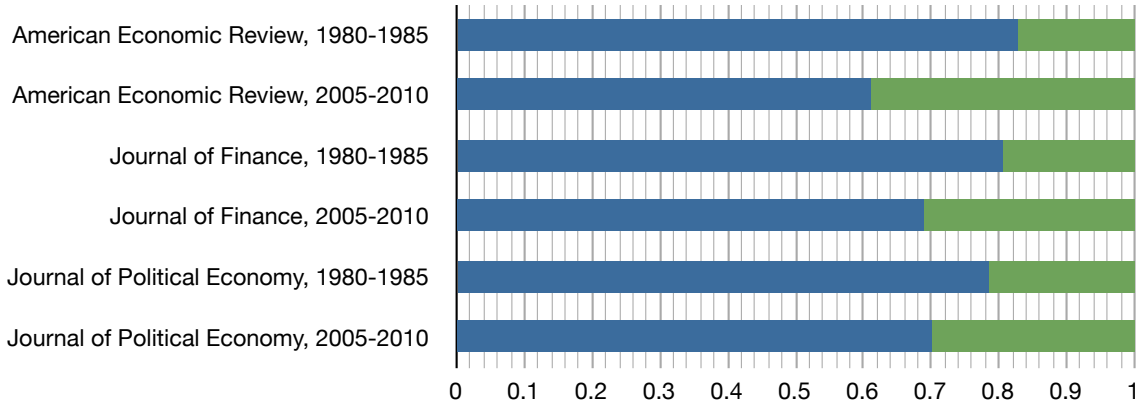


Figure 11. Share of US and non-US authors in selected journals

Panel A



Panel B