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IS FINANCE RESEARCH A “NORMAL SCIENCE”? A BIBLIOMETRIC STUDY OF THE STRUCTURE AND DEVELOPMENT OF FINANCE RESEARCH FROM 1988 TO 2007**

ABSTRACT

In the wake of the financial crisis of 2008/09, finance research has been criticized for an ineffective allocation of research efforts and a narrowing research focus. We address this discussion via a quantitative analysis of 4,064 articles published in the top four finance journals between 1988 and 2007 depicting the intellectual structure and development of finance research. We find stable structures over time that can be allocated to nine distinct research areas that represent finance research. Within each research area, both core articles and a considerable inflow of new articles exist, allowing for the systematic accumulation of knowledge. Based on our evidence, the intellectual structure of finance research can be characterized as “normal science” (Kuhn (1970)). We find no tendency towards a restricted or narrowing focus.

JEL-Classification: G00, G01.

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1 INTRODUCTION

In 2008 and 2009, the world suffered from a severe financial and economic downturn. In the wake of this crisis, research in finance was criticized for at best, not having

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prevented, or at worst, having contributed to, the crisis. For example, Colander et al. (2009) criticize the absence of “systemic crisis” research in finance and economics and conclude that research is “trapped in a sub-optimal equilibrium in which much of its research efforts are not directed towards the most prevalent needs of society” (Colander et al. (2009, 14)). More specific criticism has been leveled at deficiencies of research on incentive conflicts that “undermine the effectiveness of financial regulation and supervision in every country in the world” (Caprio, Demirgüç-Kunt, and Kane (2008, 3)), on agency problems in asset management (Calomiris (2008)), and on the mispricing of credit default swaps following unrealistic assumptions in theoretical models (Murphy (2008)). Arguing more generally, Hopwood (2009) sees a “growing distancing of the academic finance knowledge base from the complexities of practice and practical institutions” (Hopwood (2009, 549)). Similarly, the *Economist* (2009, 71) observes that “many people view the financial crisis [...] as a devastating blow to the credibility not only of banks but also of the entire academic discipline of financial economics”. For finance research, the general theme underlying these discussions is a questioning of its effectiveness, asking whether this research has become too narrow and self-referencing, thus preventing relevant new aspects to emerge.

These criticisms on the development of finance research are similar to the potential risks that Kuhn (1970) describes in general terms for an academic discipline in the state of “normal science”. In his book *The Structure of Scientific Revolutions*, Kuhn (1970) outlines the structure of the development of research areas. In his view, a state of normal science is reached when a scientific community has developed a set of generally accepted principles (“paradigms”) that unite their followers under “the same rules and standards for scientific practice” (Kuhn (1970, 11)). The agreement on fundamentals in this state has the advantage of allowing researchers to build systematically on the work of others and to extend knowledge in the area. Without such an agreement, in a “preparadigmatic” state, or if the existing foundations are disputed in a state of “scientific revolution”, researchers would debate assumptions and principles instead of extending the knowledge base (Cole (1983)). Although the state of normal science benefits the systematic development and extension of an academic field, it can lead to an “immense restriction of the scientist’s vision” (Kuhn (1970, 64)) and it does not necessarily “aim at novelties of fact or theory” (Kuhn (1970, 52)). Another important challenge in this normal science state is whether and how the scientific community deals with anomalies, i.e., research results that do not comply with the existing foundations of the discipline.

Our study contributes to the debate on the state and development of finance research that started after the financial crisis of 2008/09. To match the generalist tone of the discussion, we adopt a meta-perspective of the field of finance research by explicating its intellectual structure, as manifested in all publications that appeared in the top four finance journals between 1988 and 2007: *Journal of Finance* (JF), *Journal of Financial Economics* (JFE), *Review of Financial Studies* (RFS), and *Journal of Financial and Quantitative Analysis* (JFQA).

First, we analyze whether the structure of finance research complies with the model of normal science as defined by Kuhn (1970). Second, to address the criticism of a narrowing

focus, we review the development of the intellectual structure over four periods of time. As mentioned previously, restricting the research focus is a potential risk in the state of normal science. Our data set does not cover the years of the crisis itself, but it includes the publications that represent the discussion in the forefront of the crisis. Any potential influence in the development of the crisis originates from these earlier publications. Therefore, a better understanding of the state of financial research prior to the financial crisis of 2008/09 is an important prerequisite for a scientific discussion on its role in the development of the crisis.

The concept of normal science has already been applied to various disciplines, such as economics (e.g., Stanfield (1974)), management science (e.g., Dando and Bennett (1981)), and accounting (e.g., Chua (1986)). However, in finance research, only the notion of scientific revolution is mentioned. Jensen (1978) raises the issue of anomalies in the discussion of market efficiency; Kolb (1993) reviews whether the arbitrage pricing theory might be the successor to the capital asset pricing model (CAPM) as a main theoretical point of reference in finance.

In addition, the aim of several studies is to structure finance research and to identify core research areas. About 30 years ago, Hakansson (1979) and Weston (1981) summarized the then-recent additions to finance research. A more comprehensive recent overview by Weston (1994) presents 11 central ideas of finance research. Miller (1999), however, identifies only five main concepts that have shaped finance research: (1) portfolio selection (Markowitz (1952)), (2) CAPM (Sharpe (1964); Lintner (1965); Mossin (1966)), (3) efficient market hypothesis (Fama (1970)), (4) Modigliani-Miller propositions (Modigliani and Miller (1958)), and (5) option pricing (Black and Scholes (1973); Merton (1973a)). Other studies provide overviews of specific subdisciplines, such as initial public offerings (IPOs, e.g., Ritter and Welch (2002); Ljungqvist (2007)), corporate governance (e.g., Shleifer and Vishny (1997)), and market efficiency (e.g., Fama (1970; 1991; 1998)). However, these studies are based on the author's personal experiences and judgments, not on empirical data.

Bibliometric methods such as citation, co-citation, or publication analysis are established means to analyze an academic discipline. In finance, researchers apply these tools to identify the most influential schools (e.g., Ederington (1979); Borokhovich et al. (1995)), journals (e.g., Hamelman and Mazze (1974); Mabry and Sharplin (1985); Zivney and Reichenstein (1994); McNulty and Boekeloo (1999); Chan, Fok, and Pan (2000)), and publications or authors (e.g., Alexander and Mabry (1994); Chung, Cox, and Mitchell (2001); Arnold et al. (2003)). However, only one study uses such a technique for a review of the structure of the field. Based on the citations of publications in seven finance journals, Borokhovich and Bricker (1994) employ co-citation analysis to identify nine major areas within mainstream finance. However, their data set covers only a snap-shot of the structure in 1990 and 1991. Therefore, their findings do not allow for an analysis of the development over an extended period of time, which would be required to identify whether stable foundations of a research field indicate the state of normal science and whether there is a narrowing research focus.

The extant literature, independent of the method used, presents insightful snapshots of finance research, or parts of it only at one particular point in time. But none of the articles traces the evolution of the field, so they are of limited help in evaluating the intellectual structure and development of finance research. In addition, the results seem to diverge; different methods, unclear distinctions, and varying levels of detail further hamper the development of a clear conclusion. Thus, a coherent empirical analysis of the structure and development of financial research that uses the same method and the same data set over an extended time period is essential.

We use the bibliometric methods of citation and co-citation analysis to review the field of finance and its development during the 20 years prior to the financial crisis of 2008/09. To address whether finance research is in the state of normal science, we examine the following indicators. First, we assess whether finance research is based on generally accepted principles. These should be reflected through continuously high citation rates to a set of core publications that represent the codified knowledge of the field. Second, we analyze the intellectual structure of finance to review whether stable structures of main topics actually do exist. Hence, we use co-citation analysis to identify the main lines of research in the field of finance and track their development over four time periods (PI: 1988-1992; PII: 1993-1997; PIII: 1998-2002; PIV: 2003-2007). Combined, these indicators make it possible for us to evaluate whether finance seems to comply with the model of normal science. This state facilitates a systematic extension of the knowledge base described as cumulative science. Researchers can then rely on the accepted basis and direct their attention toward detailed and specific problems in a process called “puzzle-solving” (Kuhn (1970)).

According to Kuhn (1970), a potential risk associated with the state of normal science lies in a narrowing research focus. Thus, we also investigate the extent to which finance research runs the risk that the breadth and scope of research topics have narrowed so much that new research endeavors are increasingly confined to concentrated research areas. Hence, we examine the following indicators as well. First, based on co-citation analysis, we review the development of the lines of research over time. Although a decrease in the number of research topics might indicate a narrowing focus, the emergence of new ones might be an indicator of how receptive the discipline is toward new ideas. Of special importance in this respect would be a discussion of anomalies, which indicate how the field reacts to diverging results. Second, we are interested in the development of the age structure of citations to review how quickly new research is considered in subsequent publications and in the intellectual structure.

Our main results are first, that there are indications that research in finance, as reflected in the top four finance journals over the period from 1988 to 2007, does indeed represent normal science. We identify nine major research areas consisting of 11 to 14 research clusters during the four subperiods: (1) asset pricing, (2) market microstructure, (3) agency conflicts, (4) IPOs, (5) financial intermediation, (6) term structure, (7) corporate diversification and internal capital markets, (8) law and finance, and (9) mutual funds. At the core of these areas, a consistent set of common foundations seems

to be established. These foundations are represented by articles such as Sharpe (1964) and Lintner (1965) for asset pricing, and Rock (1986) for IPOs.

Second, we do not find strong evidence of a narrowing focus in financial research. New research clusters emerge throughout our period of analysis, (e.g., law and finance and mutual funds, both established during the period from 1998 to 2002). In addition, a more detailed analysis of the age structure of citations, and in particular, of the articles in the respective clusters, shows that new research is quickly incorporated into the knowledge base of finance, complementing and extending its older foundation.

Our work adds to the finance research literature, first, because we generate empirical data to the debate about the state of financial research before the financial crisis of 2008/09. Second, because we extend the review articles in the field of financial research with an overview of the discipline based on a large data set using bibliometric methods, also complementing similar studies in other disciplines, such as strategic management (e.g., Ramos-Rodríguez and Ruíz-Navarro (2004); Nerur, Rasheed, and Natarajan (2008)) and marketing (e.g., Hoffman and Holbrook (1993); Pasadeos, Phelps, and Kim (1998)). To the best of our knowledge, our study is the first to generate a co-citation-derived overview of the structure and development of financial research over the extended period of two decades.

The remainder of this article is structured as follows. The next section, Section 2, explains the bibliometric methods in greater detail and describes our specific dataset. Thereafter, Section 3 presents the results of our citation and co-citation analyses. Section 4 concludes this study with a summary of our results.

2 METHOD AND DATA SET

2.1 METHOD

We use the bibliometric techniques of citation and co-citation analyses to depict the structure and development of finance research. The major advantage of these methods is that, unlike qualitative reviews, they do not represent the opinion of any single expert, but the combined judgment of a huge number of experts in a field. We build our research on the assumption that articles published in the top four finance journals accurately reflect finance research and its advances. In addition, as do other bibliometric studies, we assume that citation data is an indicator of past and present activity in science (Garfield, Malin, and Small (1983)) and can serve as a valid indicator of the underlying concepts (Small (1978)).

Based on these assumptions, two main techniques have been developed (Osareh (1996a; 1996b)): citation analysis, i.e., the count of citations in selected publications, which is often used to identify the most influential papers, journals, or schools; and co-citation analysis, which analyzes pairs of articles that are cited together in one bibliography. The number of co-citations is interpreted as a measure of the intellectual

proximity between the cited publications. By analyzing a large data set, we use this similarity to derive the underlying structure of the field and thereby incorporate “the empirical consensus of hundreds of citers rather than the impressions of individuals” (White (1990, 430)).

However, some aspects require a cautious interpretation of the results of bibliometric studies. First, even though citations indicate a relationship, they might represent both supporting and opposing views of the author towards the cited work. Second, over time, some publications may become part of the general knowledge and may be incorporated in later publications so that the original publication is no longer formally cited¹. However, such effects may be limited, given the large samples used (Cawkell (1976)), the high correlation of the results of peer evaluations with citation analysis found in other studies (e.g., Moed (2005)), and the similarity of structures identified by expert nominations with co-citation analysis (e.g., Mullins et al. (1977); McCain (1986)).

In this study, we use document co-citation analysis, which allows for a detailed view of the structure of a field by focusing on the relationships between individual publications instead of authors. As in other publications using the co-citation method (e.g., Gmür (2003); Meyer, Schäffer, and Gmür (2008)), we focus on the co-citation relationships between the most-cited documents per period (approximately 200) to identify primary lines of research. However, often cited publications have inherently high co-citations and can prevail over less-cited but more closely related articles. To account for this, we must consider the co-citation value of two sources in relation to the frequency of citation. Therefore, we use the Co-Citation-score (CoCit), which has been developed for this purpose (Gmür (2003)).

For two articles A and B that are part of the most-cited publications considered for the co-citation analysis, the CoCit-score is defined as

$$\text{CoCit}_{AB} = \frac{(\text{co-citation}_{AB})^2}{\text{minimum}(\text{citation}_A; \text{citation}_B) \times \text{average}(\text{citation}_A; \text{citation}_B)} \quad (1)$$

where co-citation_{AB} is the number of times articles A and B are cited jointly, and citation_A and citation_B are the number of times articles A or B are cited individually. The CoCit-score normalizes the strength of the relationship between the two articles to values between zero (not cited together, i.e., no relationship) and one (always cited together, i.e., very close relationship).

Based on the CoCit-scores, we can depict co-citation networks as graphic representations of the intellectual proximity between the top 200 publications. We display the results of the co-citation analysis in the form of maps of clusters, each of which consists of articles with a high level of intellectual proximity. For this purpose, we use the

1 A process called “obliteration by incorporation” (Merton (1968, 28)).

network analysis software Organizational Risk Analyzer (ORA)². To display clearly defined lines of research, we include in the final graph only strong co-citation relationships, i.e., with CoCit-scores above the threshold of 0.22 (in line with other studies using the CoCit-score, e.g., Meyer, Schäffer, and Gmür (2008); Meyer, Lorscheid, and Troitzsch (2009))³.

Thus, our graphs combine different forms of groups of linked articles, pairs of two, chains or star-shaped groups purely consisting of one-to-one co-citation relationships, and interlinked groups of various sizes. To focus on the main lines of research, we include only groups of interlinked articles with at least four publications with four strong co-citation links. To establish for each group the denominations that best represent each line of research, we analyze the included articles for similarities that mark a common theme (e.g., the same research topic), starting with the most central publication, i.e., the one with the highest number of co-citation links. We discuss common themes with experts in the field, and then attach a corresponding name to each group.

We differentiate between three levels of detail among these groups. Starting with the most detailed level, we label a group of articles covering one main theme in one individual period as a “research cluster”. Second, labeled as “line of research” a series of clusters that cover the same topic across periods. Third, as a further aggregation, we note that a “research area” comprises one or more thematically linked line(s) of research.

2.2 DATA SET

We select relevant top finance journals based on recent rankings. Regardless of the method used, the rankings tend to display the same results for the top journals (e.g., citations (Chung, Cox, and Mitchell (2001); Arnold et al. (2003)), surveys (e.g., Oltheten, Theoharakis, and Travlos (2005)), and publications (e.g., Chen and Huang (2007))). Therefore, our set of journals comprises JF, JFE, RFS, and JFQA. We exclude the *Journal of Business*, which ranks fourth in the study by Arnold et al. (2003), as its focus was not limited to finance research; further, it ceased publication in 2006. Our period of analysis starts in 1988 with the first issue of the latest addition to the top four journals, RFS. Our sample ends with the last issue of the year 2007 for each journal. To analyze the development over time, we split the overall period of 20 years into four subperiods of five years each.

As in previous studies, we obtain publication and citation information from the Thomson Research Social Science Citation Index (SSCI) database and include only articles, notes, and reviews based on the database classification. The SSCI database contains the information for the full period for JF, JFE, and JFQA, and from 1990 onward for

2 <http://www.casos.cs.cmu.edu/projects/ora/index.html>.

3 Sensitivity analysis shows that the use of other threshold values does not systematically change our results, as the core, and thereby the main theme, of each cluster consists of strong co-citation relationships that remain present.

RFS. The missing two years of RFS information were added manually. We compare the publication information acquired from the SSCI database with the information on the websites of the journals or publishers to cross-check the completeness of the data. After this procedure, our final data set consists of 4,064 articles with 129,940 citations⁴ (see *Table 1*).

Table 1: Summary Statistics of the Data Set

Journal	# Articles	%	# Citations	%
Journal of Finance	1,637	40.3%	51,702	39.8%
Journal of Financial Economics	1,077	26.5%	35,647	27.4%
Review of Financial Studies	697	17.1%	24,135	18.6%
Journal of Financial and Quantitative Analysis	653	16.1%	18,456	14.2%
Total	4,064	100.0%	129,940	100.0%

In this table, # *Articles* displays the number of articles, notes, and reviews published in the journal with other types of material excluded; # *Citations* is the number of citations referenced in the identified articles; % gives the percentage of the respective total.

Because of errors caused by data entry or errors in the original bibliography, the data in the SSCI database contains several inconsistencies. For example, the article by Jensen and Meckling (1976) appears in the database with more than ten different citations. To ensure the quality of the data, we manually review and subsequently correct all 129,940 citations. Overall, we correct and align approximately 22,500 citations (17%).

As discussed above, the co-citation analysis focuses on the relationships between the approximately 200 most-cited documents per period. Therefore, we select all articles that are cited in more than 1.6% of the source articles. This threshold mirrors those of previous studies, e.g., Meyer, Schäffer, and Gmür (2008); Meyer, Lorscheid, and Troitzsch (2009). For the four periods, this procedure results in 200, 217, 215, and 230 articles, respectively.

We note that the number of researchers in the field of finance has grown steadily. For instance, between 1988 and 2007 active membership in the American Finance Association expanded by a compound annual growth rate of 1.9%⁵. This rising number of researchers is reflected in the growing number of published articles per year, which increased from 175 in 1988 to 287 in 2007 (at a compound annual growth rate of 2.6%). Hence, a greater number of articles enter the citation and co-citation analyses.

4 We excluded all citations that did not specify an author (e.g., statistical or governmental publications) to ensure the focus on scientific research.

5 See N.N. (1989-2008).

3 RESULTS

3.1 CITATION ANALYSIS

Assuming a state of normal science, the articles that embody the accepted principles of the area should always display high citation rates. Therefore, we review first the most-cited articles to identify the key papers in the field (see *Table 2*). We apply two measures to rank articles. First, we use the absolute number of citations as a measure of the overall impact of the work. Second, we use the average number of citations per year (for 20 years or since the year of publication, if later than 1988), which mitigates the effect of the longer citation period of older articles.

Table 2: Most-Cited Finance Articles 1988-2007

Article	# CITATIONS		RANK BASED ON	
	Total	Per Year	Total	Per Year
WHITE-1980-ECM-P817	353	17.7	1	2
JENSEN-1976-JFE-P305	335	16.8	2	3
FAMA-1993-JFE-P3	315	21.0	3	1
JENSEN-1986-AER-P323	313	15.7	4	5
MYERS-1984-JFE-P187	303	15.2	5	6
FAMA-1973-JPE-P607	276	13.8	6	7
BLACK-1973-JPE-P637	269	13.5	7	8
KYLE-1985-ECM-P1315	266	13.3	8	9
FAMA-1992-JF-P427	254	15.9	9	4
NEWY-1987-ECM-P703	242	12.1	10	11
MYERS-1977-JFE-P147	236	11.8	11	12
GLOSTEN-1985-JFE-P71	230	11.5	12	14
HANSEN-1982-ECM-P1029	226	11.3	13	15
COX-1985-ECM-P385	199	10.0	14	18
MERTON-1973-ECM-P867	176	8.8	15	21
ADMATI-1988-RFS-P3	170	8.5	16	22
JEGADEESH-1993-JF-P65	154	10.3	17	16
MERTON-1973-BJE-P141	150	7.5	18	29
MORCK-1988-JFE-P293	146	7.3	19	32
FAMA-1989-JFE-P23	144	7.6	20	28
CARHART-1997-JF-P57	137	12.5	26	10
LOUGHRAN-1995-JF-P23	126	9.7	34	19
FAMA-1996-JF-P55	123	10.3	35	17
LAPORTA-1998-JPE-P1113	117	11.7	45	13
DANIEL-1998-JF-P1839	94	9.4	73	20

In this table, # Citations displays the number of citations as *Total* or as the average number of citations per year since publication or for the length of the period of analysis (*Per Year*). The rankings are based on these two measures. Only the 20 highest-ranked articles for each measure are displayed. The dashed line delineates the top 20 authors based on total citations from articles that rank in the top 20 finance journals, based only on citations per year. *Annex 1* provides definitions of the journal abbreviations.

Overall, the ranking consists mainly of older articles that cover a wide range of topics, such as agency theory (Jensen and Meckling (1976)), option pricing (Black and Scholes (1973)) or multi-factor asset pricing models (Fama and French (1993)). In addition to these finance articles, some papers that examine the methods that underlie finance research can be found on the list (White (1980); Hansen (1982); Newey and West (1987)). For the highest ranked articles, the results are similar for both measures. However, the per-year measure of citations gives us different results in the second half of the ranking. Some newer articles, such as Carhart (1997) or La Porta et al. (1998), move up in the rankings and show that finance research has continued to develop new concepts. When we compare these results with those of previous citation studies, we confirm the picture of a relatively stable structure. On the basis of the number of citations of our 20 top ranked articles, 16 also appear in the ranking by Arnold et al. (2003), which covers the years 1990 to 1999 for six major journals. Ten articles appear in the ranking by Alexander and Mabry (1994), which covers the years 1987 to 1991 for four major journals.

To review the development over time, we examine the rankings in each of the four periods. Similar to the overall result, the per-period ranking in *Table 3* displays a fairly stable structure. Many of the most-cited publications from the full period appear often on the list of influential articles. Three publications rank in the top ten in all four periods (Jensen and Meckling (1976); White (1980); Jensen (1986)), and two additional publications appear in three periods (Myers and Majluf (1984); Fama and French (1992)). These five articles have influenced finance research for a long period of time. Thus, with the exception of White (1980) these publications may represent the foundations of their respective research areas.

Table 3: Most-Cited Finance Articles per Period

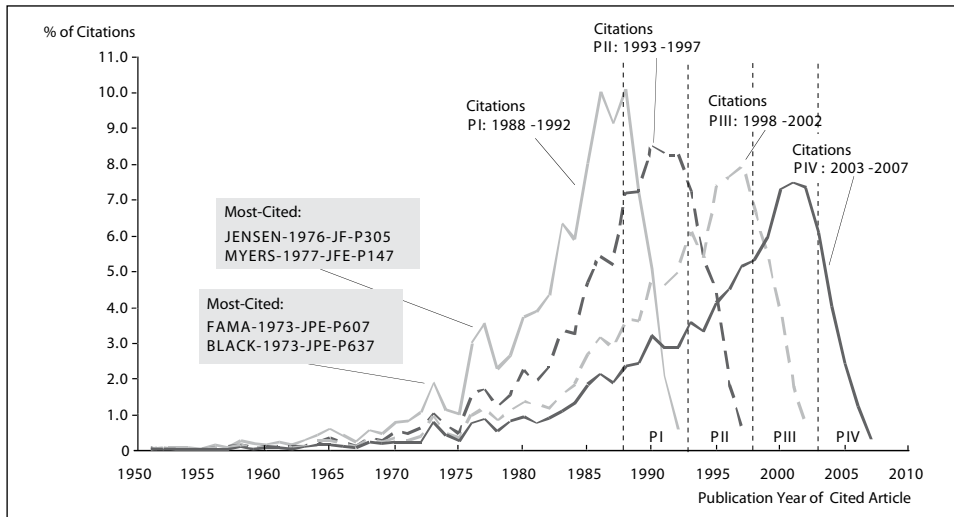
PI: 1988-1992			PII: 1993-1997		
Article	# Citations		Article	# Citations	
	Total	Per Year		Total	Per Year
JENSEN-1976-JFE-P305	83	16.6	WHITE-1980-ECM-P817	104	20.8
WHITE-1980-ECM-P817	77	15.4	KYLE-1985-ECM-P1315	84	16.8
MYERS-1984-JFE-P187	76	15.2	JENSEN-1986-AER-P323	74	14.8
JENSEN-1986-AER-P323	73	14.6	NEWY-1987-ECM-P703	69	13.8
BLACK-1973-JPE-P637	69	13.8	HANSEN-1982-ECM-P1029	67	13.4
HANSEN-1982-ECM-P1029	58	11.6	FAMA-1992-JF-P427	67	13.4
GLOSTEN-1985-JFE-P71	57	11.4	GLOSTEN-1985-JFE-P71	64	12.8
SMITH-1986-JFE-P3	57	11.4	MYERS-1984-JFE-P187	64	12.8
FRENCH-1987-JFE-P3	55	11.0	JENSEN-1976-JFE-P305	63	12.6
SCHOLLES-1977-JFE-P309	55	11.0	ADMATI-1988-RFS-P3	63	12.6

PIII: 1998-2002			PIV: 2003-2007		
Article	# Citations		Article	# Citations	
	Total	Per Year		Total	Per Year
FAMA-1993-JFE-P3	121	24.2	FAMA-1993-JFE-P3	157	31.4
FAMA-1992-JF-P427	86	17.2	FAMA-1973-JPE-P607	122	24.4
JENSEN-1976-JFE-P305	85	17.0	MYERS-1984-JFE-P187	106	21.2
WHITE-1980-ECM-P817	82	16.4	JENSEN-1976-JFE-P305	104	20.8
JEGADEESH-1993-JF-P65	72	14.4	FAMA-1992-JF-P427	99	19.8
BLACK-1973-JPE-P637	71	14.2	JENSEN-1986-AER-P323	96	19.2
JENSEN-1986-AER-P323	70	14.0	WHITE-1980-ECM-P817	90	18.0
FAMA-1973-JPE-P607	66	13.2	LAPORTA-1998-JPE-P1113	89	17.8
KYLE-1985-ECM-P1315	62	12.4	NEWWEY-1987-ECM-P703	83	16.6
FAMA-1996-JF-P55	61	12.2	CARHART-1997-JF-P57	76	15.2

In this table, # Citations displays the number of citations as Total or as the average number of citations per year since publication or for the length of the period of analysis (Per Year). Author/articles in bold are part of the top 10 most influential articles in at least three of the four periods. Annex 1 provides definitions of the journal abbreviations.

To complement the results, we analyze the age structure of citations across all publications. For each period, we chart the publication year of the cited articles and compare it to the number of citations. Thus, we create an indication of the influence of recent and older research (see Figure 1).

Figure 1: Age Structure of Citations



In this figure, % of Citations displays the percentage of citations in the respective year on the vertical axis, tabulated against the publication year of the cited article (Publication Year of Cited Article) on the horizontal axis. Publication years before 1950 are not displayed. The dotted vertical lines indicate the period from which the citing articles have been drawn. Annex 1 provides definitions of the journal abbreviations.

First, recent publications are the primary source of subsequent articles, since the maximum number of citations lies five to eight years before the end of the period. This pattern is consistent over all periods. In light of the generally lengthy process that extends from the development of a new research paper to its publication, this indicates that finance quickly takes recent research into account. Second, at the same time, some older articles remain important in all periods, as indicated by the spikes (e.g., in 1973 and 1976). This pattern is driven by a small number of often cited articles that are of continuous interest for new research, such as Black and Scholes (1973), Fama and MacBeth (1973), or Jensen and Meckling (1976). Finally, even though the total of citations is dominated by recent articles, older publications gain importance over the different time periods: in Period I, only 48% of the citations had been published earlier than eight years before the end of the period, compared to 64% in Period IV. This development also appears in the average ages of the citations, which increase from 7.5 years in Period I to 10.7 years in Period IV⁶.

Overall, our citation analysis reveals that although some classical papers dominate the citation rankings, finance research is characterized by a research front that moves forward continuously. Both observations are characteristic of the state of normal science. The emerging new publications reflect the ongoing extension of the knowledge base in the puzzle-solving process.

3.2 CO-CITATION ANALYSIS

In this section, we employ the bibliometric method of co-citation analysis to identify main lines of research and analyze their development over time. This allows us to depict the state of finance research and analyze whether it has narrowed over the period from 1988 to 2007.

We begin with an overview of the major research areas that represent the overall body of finance research in *Figure 2*. Following the split of our period of observation into four subperiods, the overview also demonstrates these areas' evolution over time. Hence, we can conclude whether finance research consists of continuous research activity in major research areas and whether the diversity of different lines of research has increased or decreased from 1988 to 2007.

The overview is followed by a detailed analysis of each research area across all four time periods, giving additional indications of the state of finance research. In the case of normal science, the research areas and clusters should be built around a core of main publications that provide stable foundations. As a complementary indicator, we identify whether additional newly emerging publications enter the respective clusters, representing the new research generated in the process of puzzle-solving. These results may

6 When we test the differences between the individual periods, we find that all differences are statistically significant at the 1% level. For the average age of citations, we use *t*-tests and because the age of citations variable is not fully normally distributed, we confirm the results using Wilcoxon rank-sum tests. For the articles published more than eight years before the respective period's end, we use χ^2 -tests.

evolve in two ways. First, emerging publications function as the nucleus of a new research cluster in the current or a following period, indicating an extension of finance research. Second, emerging publications extend the perspective of an existing cluster with new or updated results and remain part of this cluster, until newly emerging publications eventually replace it. Embodying complementary perspectives, both the overview and the detailed analysis allow us to collect indications to evaluate whether finance research can be considered normal science and to determine whether finance research has become narrower during the past two decades.

3.2.1 PERIOD OVERVIEW

For each of the four periods, we identify a detailed set of 11 to 14 individual research clusters that, when combined, represent the structure of finance research (see *Annex 3* to *Annex 6*). The resulting continuity of research clusters throughout the four periods is remarkable. Although calculated separately for each period, the majority of the identified research clusters represent the same set of nine major research areas. *Figure 2* provides the compressed overview of the evolution of the structure of finance research.

Over time, some topics are always under discussion and remain important in both research clusters and areas during at least three of four periods: asset pricing (comprising three lines of research: macro factors, general models, anomalies), market microstructure, agency conflicts (corporate control, ownership, capital structure), IPOs (underpricing, long-term returns), financial intermediation, and term structure. Other new areas evolve in Period III (corporate diversification and internal capital markets, law and finance, mutual funds), and, with the exception of the area of mutual funds, remain present in Period IV.

When we address the potential narrowing of finance research, our results do not indicate that finance research has become narrower, focusing on fewer topics. New research clusters are continually developed and replace or extend existing clusters. In addition, no cluster becomes dominant; instead, all remain in a similar range in terms of size and number of citations. Furthermore, the overall structure of the clusters does not show signs of increased concentration, given that the Herfindahl index of the intellectual structure remains at similar, low levels in each period (see *Table 4*)⁷.

7 The Herfindahl index is a measure of concentration, which we apply to the identified intellectual structures. We calculate it as $\sum_{j=1}^n s_j^2$, in which j is the respective cluster, and s_j is the fraction of articles in cluster j in relation to the total number of articles in the intellectual structure. Its values lie between zero (fully dispersed) and one (fully concentrated).

Figure 2: Development of Finance Research Areas across Periods

Research Area		PI: 1988-1992		PII: 1993-1997		PIII: 1998-2002		PIV: 2003-2007					
		Cluster	# Citations	Cluster	# Citations	Cluster	# Citations	Cluster	# Citations				
Asset Pricing	Macro Factors	I.8d	10	314	II.5	11	267	III.5	6	157	IV.9	13	409
					II.11	4	187						
	General Models	I.8a	14	453									
		I.8b	6	173	II.6	9	237	III.7a	6	215	IV.8	7	200
		I.8e	9	218									
	Anomalies	I.8c	8	216	II.3a	5	108						
I.5		6	161	II.3b	7	211	III.7b	17	706	IV.10	15	794	
I.9		4	94										
Market Microstructure		I.6	11	318	II.8a	7	182						
					II.8b	9	309						
					II.8c	9	223	III.1	9	272			
					II.9	5	92						
Agency Conflicts	Market for Control	I.1	6	109									
	Ownership	I.3	8	207	II.4	5	134				I.12	4	150
		I.7	12	343									
Capital Structure	I.2	12	422	II.2	5	161				IV.4	9	303	
										IV.6	6	160	
Initial Public Offerings	Underpricing	I.4	10	211	II.7	15	342	III.10	4	91	II.11	16	500
	Long-Term Return							III.6	12	414	IV.2	8	259
Financial Intermediation					II.1	6	123	III.2	5	132	IV.5	6	181
Term Structure					II.10	5	142	III.4	9	237	IV.3	5	144
Corporate Diversification and Internal Capital Markets								III.3	6	169	IV.7	7	186
Law and Finance								III.9	4	90	IV.1	14	519
Mutual Funds								III.8	13	361			

In this figure, *Research Area* defines the common topic of a group of clusters; the circle size represents the cluster size (also indicated by the number); and *Cluster* gives the cluster identifier. A dotted line around several circles indicates a larger cluster with several subclusters. *# Citations* gives the number of citations that the articles in the cluster received in the given period. *Annex 2* contains a table with the name and summary statistics of the respective clusters.

Table 4: Statistics on the Intellectual Structure across Periods

	PI: 1988-1992	PII: 1993-1997	PIII: 1998-2002	PIV: 2003-2007
# Cluster > 3 Publications	13	14	11	12
Herfindahl Index	0.085	0.083	0.112	0.099
Empirical Papers	59%	61% -	62% -/-	73% */**
Articles from the 1970s	16.4%	8.8% *	5.5% -/**	3.6% -/***
Articles from the 1980s	80.2%	52.9% ***	22.0% ***/***	15.5% -/***
Articles from the 1990s	0.0%	36.3% ***	68.1% ***/***	48.2% ***/***
Papers from Finance Journals	72.4%	77.5% -	83.5% -/*	87.3% -/***
Papers from Non-Finance Journals (thereof Economics Journals)	27.6% (23.3%)	22.5% - (16.7%) -	16.5% -/* (12.1%) -/**	12.7% -/*** (10.0%) -/***

In this table, # Cluster displays the number of clusters with at least four publications (we note that we count subclusters as a separate cluster); *Herfindahl Index* is a measure of concentration of the complete intellectual structure with values between zero (fully dispersed) and one (fully concentrated); *Empirical Papers* is the percentage of papers using empirical data (e.g., event studies, regressions, surveys) in the identified clusters; *Articles from the 19X0s* gives the percentage of articles in the identified clusters published in the given period; and *Papers from Finance/Non-Finance Journals* shows the percentage of articles in the identified clusters that were published in finance or non-finance journals, based on the U.S. Library of Congress Classification. *, **, *** indicate differences to the previous period/period I at the 10%, 5%, 1% significance levels, respectively, based on χ^2 -tests.

The age distribution of the articles in the clusters shows a pattern similar to that of the citation analysis; there is a strong focus on newer research that is complemented by older articles. However, although no previous indicator shows any sign of a narrowing focus or decreasing diversity of finance research, a trend toward more pronounced self-referencing gives an ambiguous picture. In Period I, the majority of articles in the research clusters come from the area of finance (72.4%), with economics as the second most important point of origin (23.3%). Throughout our period of analysis, the influence of finance journals expands to 87.3%, but economics journals lose influence (10% in Period IV). This development could indicate a stronger differentiation from economics research. However, this increased self-referencing may also entail the risk that, going forward, the diversity of topics and concepts may decrease.

In summary, these overviews of the results of the co-citation analyses indicate, in line with the citation analysis, that finance research can be characterized as normal science, without significant indications of a narrowing focus.

3.2.2 INDIVIDUAL RESEARCH AREAS

In this section, we analyze the development of individual research areas to complement the previous results with a detailed view of the particular changes. Aside from the

previously identified remarkable continuity of lines of research over time, we expect a stable set of one or several basic sources at the core of the clusters, complemented by new sources representing new ideas and concepts.

ASSET PRICING

The research area of asset pricing is the largest across all periods. It comprises a stable set of three main lines of research that are each present in each timeframe. The first line, macro factors (I.8d, II.5, II.11, III.5, IV.9), reviews the influence of macroeconomic factors (e.g., term structure, inflation) on asset prices. In addition, issues pertaining to statistical techniques are discussed. The foundations of this cluster are very stable; three articles are present in all periods (Keim and Stambaugh (1986); Campbell (1987); Fama and French (1988)) and three articles are present in three periods (Fama and Schwert (1977); Campbell and Shiller (1988); Fama and French (1989)), indicating the accepted foundations. Still, in each period, individual papers complement the structure with new ideas (e.g., in Period IV, Campbell and Hentschel (1992); Glosten, Jagannathan, and Runkle (1993); Stambaugh (1999); Lettau and Ludvigson (2001)).

The second line of research, general models (I.8a-b, e, II.6, III.7a, IV.8), includes the classic capital asset pricing models (CAPM). In Period I, this line has three subtopics that pertain to the general models themselves (I.8a), empirical tests of these models (I.8b), and topics regarding the methods used to examine the volatility or variance in asset returns (I.8e). In Period II, the line of research develops into a single cluster, incorporating parts of the test discussion (Fama and MacBeth (1973); Roll (1977)). Although this second line shrinks further to only six publications in Period III, a new aspect enters the cluster with Ross' (1976) arbitrage pricing theory. Although there are some changes in the structure, the foundations for this cluster remain stable in all three periods with Sharpe (1964), Lintner (1965), Merton (1973b), and Fama and MacBeth (1973). In Period IV, a significant change occurs. Instead of the classic models, a cluster consisting of new techniques evolves. The new cluster, IV.8, is asset valuation with stochastic volatility and jumps. It also covers the area of option pricing which has not been present in the clusters of previous periods.

The third line of research in the asset pricing area, the discussion of anomalies, commonly referred to as behavioral finance (I.8c, I.5, I.9, II.3a-b, III.7b, IV.10), displays an inconsistent development pattern. In Period I, it comprises two large clusters that deal with studies on contradictory results that do not fit with the classic form of asset pricing models (I.8c) and two additional return anomalies, the size effect and the January effect (I.5). The small Cluster I.9 focuses on short-term return patterns across a week or a day. In Period II, the general ideas are again present in two clusters, one (II.3a) that focuses on overreaction in the stock market to news, clustered around papers by De Bondt and Thaler (1985; 1987), and the second, II.3b, which focuses on the discussion of multi-factor models as an alternative to the one-factor CAPM. These ideas are closely clustered around Fama and French (1992). However, these clusters do not build on the publications from the previous period.

In Period III, the topic expands significantly from Period II and is dominated by the multi-factor model of Fama and French; five of their articles are part of the subcluster (Fama and French (1992; 1993; 1995; 1996; 1998)). This subcluster is one of the major areas of research in the 1990s, during which period 12 papers enter the cluster for the first time. They complement the earlier studies on this topic by Banz (1981) for the size factor and by Fama and French (1992) for the development of the Fama and French model. In Period IV the cluster remains similar in size, and the same papers remain central (Fama and French (1992; 1993; 1996)). In addition, five new papers that examine possible explanations for the anomalies or adjustments to asset pricing models that capture these effects enter the cluster. One of them (Grundy and Martin (2001)) soon becomes the central paper. Overall, although this line of research is present in all periods and becomes more compact, evolving from three clusters to one, there are no papers from Period I that are still present in Period IV. However, three papers from Period II remain important for the subsequent periods (Fama and French (1992; 1993) and Lakonishok, Shleifer, and Vishny (1994)), indicating that the original foundations for this area were probably developed and accepted during this period. Interestingly, ideas from other clusters are incorporated, as Carhart (1997) changes from the mutual fund cluster in Period III to the anomalies cluster in Period IV.

In summary, the development of the asset pricing research area shows its continuous importance in the field. Stable foundations can be identified for all three lines of research. However, this does not lead to the exclusion of innovative research, as the new Cluster IV.8 and a permanent inflow of newer papers demonstrate.

MARKET MICROSTRUCTURE

The chain of clusters on market microstructure topics (I.6, II.8a-c, II.9, III.1) starts with a dense cluster (I.6) in Period I that is centered around articles by Easley and O'Hara (1987) and Glosten and Harris (1988). These papers, complemented by Admati and Pfleiderer (1988), provide the nucleus for three distinct subclusters (II.8a-c) that unfold in the next period. With the exception of an essay by Bagehot (1971), in Period I the cluster contains only theoretical models, including the classic publication by Demsetz (1968). In Period II, the topic grows and spreads into four subclusters. Of these, three related market microstructure clusters deal with the issues of bid-ask spreads (II.8a), dealer behavior (II.8b), and general patterns of security market microstructures (II.8c). The first builds on the work by Glosten and Harris (1988) and is clustered around papers by Hasbrouck (1988) and Stoll (1989). Most articles in this cluster develop or adjust a model of the components of the bid-ask spread and then test this model empirically. The second subcluster (II.8b) contains theoretical models that examine the behavior of dealers or market makers and price formation in stock exchanges. This subcluster builds on the work by Easley and O'Hara (1987) and clusters around Glosten and Milgrom (1985). Subcluster II.8c extends the work by Admati and Pfleiderer (1988) and discusses, through both empirical and theoretical papers, the general patterns of securities markets. At the core, Jain and Joh (1988) and Foster and Viswanathan (1993) focus mainly on the patterns of volume and prices across a

day or week. These studies are complemented by two articles that appear in the asset pricing anomalies discussion in the previous period (Wood, McNish, and Ord (1985); Harris (1986)). The fourth cluster (II.9) consists exclusively of recently published empirical studies on exchange structures and spreads, relying on Christie's work (Christie and Huang (1994); Christie and Schultz (1994); Christie, Harris, and Schultz (1994)). In the third period, research on market microstructure themes retreats into one cluster centered around Glosten and Milgrom (1985). However, three new papers (Hasbrouck and Sofianos (1993); Madhavan and Smidt (1993); Madhavan, Richardson, and Roomans (1997)) show that the area still incorporates new aspects. Nevertheless, in Period IV, it cannot be identified as a separate cluster.

Overall, the research area on market microstructure is characterized by a consistent core of six studies over the three periods (Easley and O'Hara (1987); Admati and Pfleiderer (1988); Glosten and Harris (1988); Copeland and Galai (1983); Glosten and Milgrom (1985); Kyle (1985)).

AGENCY CONFLICTS

Research regarding agency conflicts relates to three main lines of research. The first line, the market for corporate control (I.1), constitutes of a single cluster that analyzes shareholder wealth effects related to decisions in the market for corporate control. An example is the adoption of poison pills in the corporate charter. While this line of research is only present in Period I, the second line, ownership, turns up in three periods (I.3, I.7, II.4, IV.12). In Period I, it consists of two clusters. The first (I.3) deals with various aspects of the effects of the ownership structure, e.g., voting behavior, share repurchases, or management ownership. The second cluster (I.7) relates not only to ownership but also to the third main line of research, capital structure. It focuses on the theoretical evaluation of two related topics: agency conflicts that result from the separation of ownership and control, and determinants of the capital structure of companies.

The discussion of these topics centers on the articles by Jensen and Meckling (1976) and Myers (1977). One subset of the clusters with empirical publications by Warner, Watts, and Wruck (1988) and Weisbach (1988) adds another aspect to cluster 1.7: management change. In Period II, this dual role ends, such that only the part that focuses on management control and turnover as part of the ownership discussion (Warner, Watts, and Wruck (1988); Weisbach (1988)) continues in Cluster II.4. Cluster I.2 presents the third main line of research regarding capital structure. This cluster examines the announcement effects of adjustments to the capital structure, such as debt or equity offerings, centered around the article by Myers and Majluf (1984). The substructure of Bhattacharya (1979), Aharony and Swary (1980), John and Williams (1985), and Miller and Rock (1985) studies the related topic of dividend policy. In Period II, this cluster is again present (II.2) but significantly smaller, with only five publications. However, the main theme from the previous period is continued with four papers that are still part of the cluster: Myers and Majluf (1984); Asquith and Mullins (1986); Masulis and Korwar (1986); Mikkelsen and Partch (1986).

In Period III, none of these topics is significant enough to warrant being identified as a separate cluster. Nevertheless, the ongoing relevance of the area can be seen in the revival in Period IV. The ownership discussion reappears as a small cluster (IV.12) related to Cluster I.3 in Period I, with two articles still part of the line of research (Demsetz and Lehn (1985); Morck, Shleifer, and Vishny (1988)). However, the management control and ownership discussion from Period II does not reappear. For the line of research on capital structure, Cluster IV.4 continues the discussion from Cluster I.7, with three articles from Period I forming the foundation of the cluster (Myers (1977; 1984); Titman and Wessels (1988)). Nevertheless, these foundations are complemented by new papers that have not been part of a cluster before (e.g., Baker and Wurgler (2002); Fama and French (2002)). In addition, the capital structure discussion is supplemented in Period IV with another cluster (IV.6) that focuses less on the agency side and more on the valuation side of corporate financing. This cluster consists primarily of newer articles from the mid-1990s, but also includes one older publication (Merton (1974)).

Overall, compared to most of the previous clusters, the area of agency conflicts exhibits less clear patterns of normal science, because the topics are diverse and not stable through time. Nevertheless, common foundations are present for topics that do appear more than once, indicating that there are certain accepted bases of research.

INITIAL PUBLIC OFFERINGS

The area of IPOs starts as a closely intertwined cluster (I.4) in Period I, dealing mainly with asymmetric information studies as explanations of the underpricing phenomenon. Central articles include Beatty and Ritter (1986), Rock (1986), and Ritter (1987). In the second period, both the structure and the main themes are unchanged (II.7). However, six new articles that complement the structure add new topics to the existing debate, e.g., Carter and Manaster (1990) on the issue of investment bank reputation. In addition, Ritter (1991) and Loughran and Ritter (1995) study the emerging issue of long-run underperformance of IPOs. In the third period, this line becomes a stand-alone cluster (III.6), still based on Ritter (1991) and Loughran and Ritter (1995). These studies are complemented by relatively recent (mainly from the second half of the 1990s) articles covering issues on the measurement of long-term return performance (Barber and Lyon (1997); Kothari and Warner (1997); Lyon, Barber, and Tsai (1999)) and also empirically analyzing different aspects of long-run underperformance, such as initial or seasoned public offerings and dividend changes. In the fourth period, the topic still centers on the main paper of the previous period, but is smaller and less dense than before (IV.2). New papers by Baker and Wurgler (2000) and Mitchell and Stafford (2000) complement the structure. Research on the underpricing phenomenon, which shrinks to a small cluster (III.10) in Period III, regains momentum in the wake of the so-called "Dot-com bubble" (IV.11), as evidenced by newer articles such as Ljungqvist and Wilhelm (2003) and Loughran and Ritter (2004). However, the foundations from Period I, with Ritter (1984), Beatty and Ritter (1986), and Rock (1986), remain the same.

We identify stable foundations for the chain of IPO clusters that center around research on the underpricing phenomenon and long-run underperformance. The basic underlying themes remain intact over all four periods, with some core articles present throughout all periods (Ritter (1984); Beatty and Ritter (1986); Rock (1986)). These articles are complemented by a changing set of new articles that evolve as part of the extension of the knowledge base. Some of these papers are integrated into the commonly accepted intellectual basis (e.g., Ritter (1991); Loughran and Ritter (1995)), but then branch off into a separate line. Others are subsequently replaced by emerging topics. Especially in the wake of the Dot-com bubble, a wave of new articles contributes to the growing size of the cluster, thus indicating a widening focus of the area of IPO research.

FINANCIAL INTERMEDIATION

The area of research on financial intermediation (II.1, III.2, IV.5) is relatively small and clusters around several closely linked papers that deal with the role and efficiency advantages of financial intermediaries, including both theoretical models and event studies. The central publication in Period II is Diamond (1991). In Period III, the second period of this area's existence, both structure and size of the cluster remain nearly unchanged, still building on the original foundations introduced in the previous period. No additional article enters this cluster, and Lummer and McConnell (1989) no longer appear. In the fourth period, although the small size and high density of the area remain unchanged, Diamond (1991) and Rajan (1992) from Period II are at the core of the cluster. These two papers are complemented by the research of Petersen and Rajan (1994; 1995; 2002), which explains aspects of the lender company relationship based on data from a specific survey.

Overall, although only a small cluster, financial intermediation shows a consistent pattern in terms of foundations, with two articles present in all three periods. However, this basis is not extended strongly. A new perspective of the underlying research topics only emerges in the last period.

TERM STRUCTURE

The area of term structure (II.10, III.4, IV.3) is a new development in Period II that is based on two articles that are part of the asset pricing models cluster in Period I (Vasicek (1977); Cox, Ingersoll, and Ross (1985)). In Period II, these articles are supplemented by three newer articles from the 1990s, focusing on theoretical models of interest rate and term structure development (Chan et al. (1992); Heath, Jarrow, and Morton (1992); Longstaff and Schwartz (1992)) and differentiating into a new cluster. In Period III, all but one (Longstaff and Schwartz (1992)) of these articles remain present, and five newer publications extend the cluster (Chen and Scott (1993); Pearson and Sun (1994); Ait-Sahalia (1996); Duffie and Kan (1996); Duffie and Singleton (1997)). Although the cluster shrinks to five publications in Period IV, the foundations remain the same (Vasicek (1977); Cox, Ingersoll, and Ross (1985)). However, two new papers,

Dai and Singleton (2000) and Duffee (2002), evaluate affine models of interest rates and add innovative ideas to the area.

Overall, the area of term structure has a stable foundation of two articles across all periods. In addition, each time frame extends the knowledge base with new results that are quickly incorporated into the cluster.

CORPORATE DIVERSIFICATION AND INTERNAL CAPITAL MARKETS

In the third period, the new and closely interrelated Cluster III.3 emerges, representing the research area on corporate diversification and internal capital markets. It is dominated by what was then recent research; the oldest article is Lang and Stulz (1994). This cluster mainly uses large-scale empirical studies, but it also includes two theoretical models (Stein (1997); Rajan, Servaes, and Zingales (2000)). In the next period, the homogeneous cluster (IV.7) hardly changes, but the two publications by Scharfstein and Stein (2000) and Maksimovic and Phillips (2002) enrich the discussion.

LAW AND FINANCE

The area of law and finance (III.9, IV.1) emerges in the third period as a small cluster of four articles, but grows into one of the largest and heavily cited clusters of the fourth period. This relevance has perhaps been initiated by the extensive work of La Porta and his colleagues, who are represented with five publications: La Porta et al. (1997; 1998; 1999; 2000; 2002). Of these, three, including the eponymous publication by La Porta et al. (1998), are already part of the previous period. However, in Period IV, 11 new papers are exemplars of the rich discussion in this area. The cluster focuses on regressions and cross-country data.

MUTUAL FUNDS

Cluster III.8 deals with the performance of classic mutual funds, excluding other forms like hedge funds, and is the largest new cluster to develop in Period III. It comprises 13 articles without a direct link to a previous cluster. Except for the benchmark article by Jensen (1968), which pioneered the measurement of fund performance against the CAPM, all articles were published in the 1990s and use empirical data. The central paper is Carhart (1997).

This cluster represents a unique feature in the development of finance research in our observation period. It emerges as a large, homogeneous, and highly cited cluster, and then disappears from the intellectual structure in the next period.

SUMMARY RESEARCH AREAS

As a major result of our detailed analysis of the different research areas, we find further support that finance research can be considered normal science. The reasons include a stable set of underlying articles for seven of nine research areas that are present across time. This result is particularly remarkable, given the increase of finance researchers over the investigated time period. The only deviations from this result are the area of agency conflicts with a more diffuse development, and the area of mutual funds, which is only present in one period. Another indicator is that researchers can extend knowledge in the field by building on the accepted foundations. This puzzle-solving process is clearly evident in the individual clusters, in which new articles complement and extend the common bases.

Another aspect described by Kuhn (1970) and related to normal science appears in the development of individual clusters. In a mature science, some results will not fit the current foundations. According to Kuhn (1970), these anomalies do not lead to a direct challenge of the accepted basics; instead, they are kept separate for further investigation. This pattern is visible in the research line anomalies belonging to the research area of asset pricing. This stream experiences significant growth and enjoys high levels of citations. However, except for the multi-factor models by Fama and French (1992; 1993), we have not so far been able to identify an established foundation. Nevertheless, this active engagement can be seen as a positive indicator of the ability of the community to address new and unresolved issues.

4 CONCLUSION

Given the debate about the role that finance academia has played in the financial crisis of 2008/09, our study contributes empirically derived information on the state and development of finance research in the forefront of the crisis. We use the bibliometric techniques of citation and co-citation analysis to depict the intellectual structure and development of finance research, as manifested in the top four finance journals (JF, JFE, RFS, JFQA) between 1988 and 2007. We first analyze whether finance research can be considered normal science (Kuhn (1970)). Second, we review the development of finance research for signs of a narrowing, more restricted focus, which is a potential risk in the state of normal science.

Our first main result is that finance research can be classified as normal science, in which research is “firmly based upon one or more past scientific achievements” (Kuhn (1970, 10)) and cumulative science is fostered. We identify outstanding articles that are positioned highly in both the overall and the per-period ranking of the most-cited articles. Examples are Jensen and Meckling (1976) for agency theory and Black and Scholes (1973) for option pricing. These articles shape their respective fields for a long period of time and form the basis for current research. Similarly, in our analysis of lines of research, we find stable structures over time that can be allocated to nine distinct research areas that represent finance research. In addition, we identify several articles

that are continuously present in the respective lines of research, such as Sharpe (1964) and Lintner (1965) for the asset pricing models line or Vasicek (1977) and Cox, Ingersoll, and Ross (1985) for the term structure of interest rates line. Within each research area, both core articles and a considerable inflow of new articles exist, allowing for the systematic accumulation of knowledge. Overall, these results indicate that finance research can be appropriately considered normal science.

Our second main result is related to a potential risk associated with a state of normal science and the criticism of a narrowing research agenda in the field of finance. Based on several indicators, we cannot find signs of a narrower or more restricted focus. Each period is characterized by a set of 11 to 14 research clusters that cover a broad range of topics. The concentration level of the full intellectual structure remains almost constant throughout these periods. Some of the resulting nine research areas are of ongoing interest and appear in at least three of four periods (asset pricing, market microstructure, agency conflicts, IPOs, financial intermediation, term structure). Other new areas, such as corporate diversification and internal capital markets, law and finance, and mutual funds, evolve and are quickly incorporated into the overall structure of the field, indicating that finance research remains open to new topics. This incorporation of new ideas is also reflected by the rapid integration of new research, which is displayed in the individual clusters and in the overall age structure of citations. We believe that it is important to recognize that openness toward new research contributions is not limited to entirely new topics. Finance research appears to be receptive to contributions that do not immediately comply with existing foundations, as the active and highly cited discussion of anomalies in the asset pricing line of research demonstrates. Overall, the evidence of our analysis indicates that neither the criticism of a narrow set of topics of finance research nor a restriction to old concepts is warranted. In the future, it will be interesting to see how the structure of finance research might change after the current crisis.

The results of our study are limited in at least two ways. First, we focus our analysis on research published in the four highest-ranked finance journals and exclude other means of scientific communication, such as more specialized journals, books, or conference presentations. Future research that includes these media would be interesting, since doing so might add further areas to the structure of finance research because more specialized topics would be covered. Second, bibliometric studies are prone to the general criticism that possibly not all references relevant to the article are explicitly cited, and that not all citations are necessarily based on an intellectual link to the paper. Potential additional effects might include citation networks among groups of researchers, self-citations, or citations made to please the editor or the potential reviewer of the target journal (MacRoberts and MacRoberts (1989; 1996)). In addition, all citations are weighted equally, even though their importance may differ. Although these potential shortcomings must be considered, we expect that, given the large number of articles on which our analysis is based, these potential distortions should even out across the sample.

Annex 1: Journal/Title Abbreviations

Journal/Title Abbreviation	Full Title/Name
AER	<i>American Economic Review</i>
BJE	<i>Bell Journal of Economics</i>
BPE	<i>Brookings Papers on Economic Activity</i>
ECM	<i>Econometrica</i>
FAJ	<i>Financial Analysts Journal</i>
FM	<i>Financial Management</i>
JACF	<i>Journal of Applied Corporate Finance</i>
JAE	<i>Journal of Accounting and Economics</i>
JB	<i>Journal of Business</i>
JBF	<i>Journal of Banking and Finance</i>
JEC	<i>Journal of Econometrics</i>
JEDC	<i>Journal of Economic Dynamics and Control</i>
JET	<i>Journal of Economic Theory</i>
JF	<i>Journal of Finance</i>
JFE	<i>Journal of Financial Economics</i>
JFI	<i>Journal of Financial Intermediation</i>
JFQA	<i>Journal of Financial and Quantitative Analysis</i>
JFXI	<i>Journal of Fixed Income</i>
JLE	<i>Journal of Law and Economics</i>
JME	<i>Journal of Monetary Economics</i>
JPE	<i>Journal of Political Economy</i>
JPM	<i>Journal of Portfolio Management</i>
MF	<i>Mathematical Finance</i>
QJE	<i>Quarterly Journal of Economics</i>
RES	<i>Review of Economic Studies</i>
RESTA	<i>Review of Economics and Statistics</i>
RFS	<i>Review of Financial Studies</i>
RJE	<i>RAND Journal of Economics</i>
1976 P M AM STAT ASS	<i>Proceedings of the 1976 Meetings of the American Statistical Association</i>
STUDIES THEORY CAPIT	<i>Studies in the Theory of Capital Markets</i>

Annex 2: Overview and Summary Statistics of Finance Research Clusters

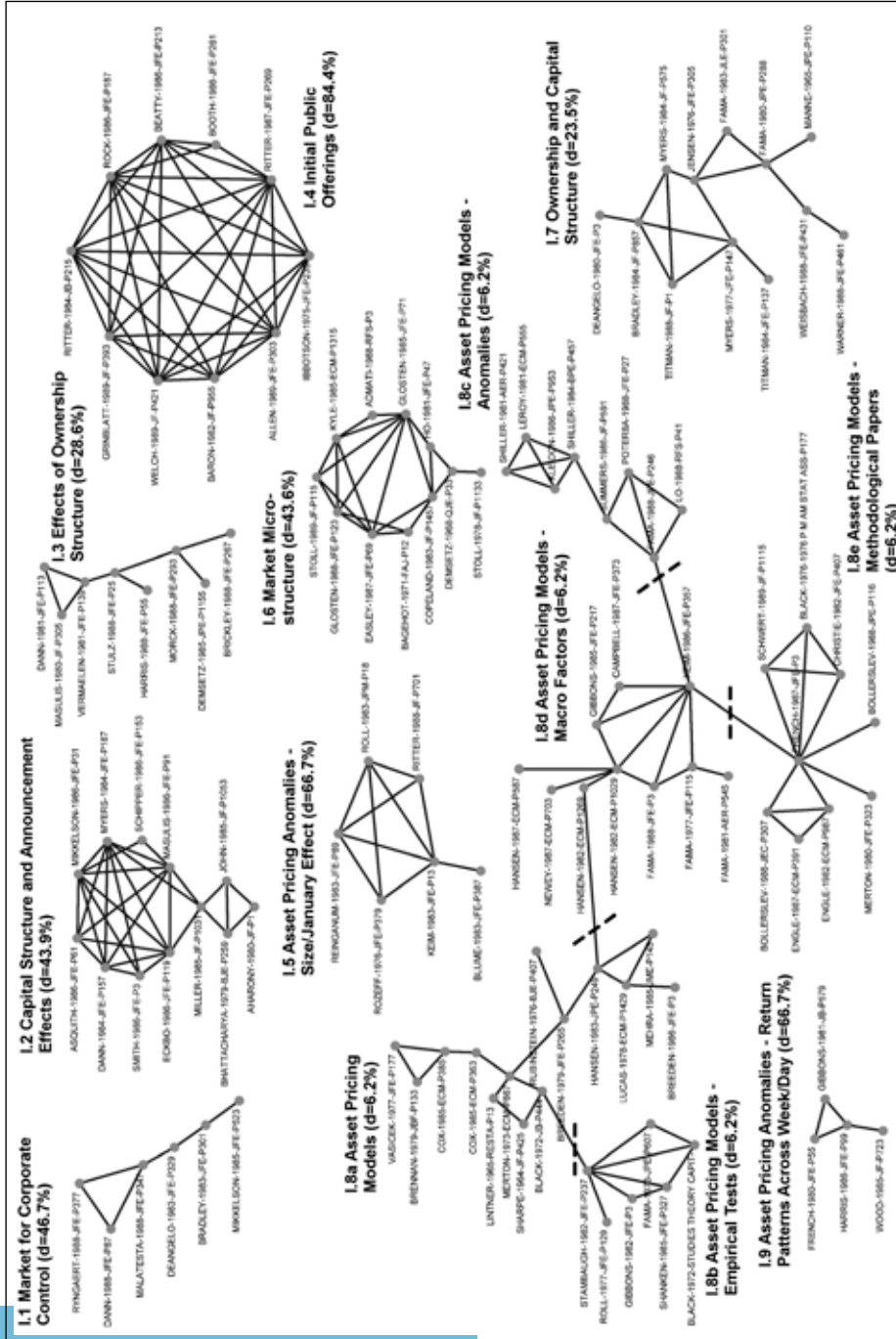
PI: 1988-1992				
N	Cluster	# Articles	Density	# Citations
I.1	Market for Corporate Control	6	46.7%	109
I.2	Capital Structure and Announcement Effects	12	43.9%	422
I.3	Effects of Ownership Structure	8	28.6%	207
I.4	Initial Public Offerings	10	84.4%	211
I.5	Asset Pricing Anomalies – Size/January Effect	6	66.7%	161
I.6	Market Microstructure	11	43.6%	318
I.7	Ownership and Capital Structure	12	23.5%	343
I.8a	Asset Pricing Models	14	6.2%	453
I.8b	Asset Pricing Models – Empirical Tests	6	6.2%	173
I.8c	Asset Pricing Models – Anomalies	8	6.2%	216
I.8d	Asset Pricing Models – Macro Factors	10	6.2%	314
I.8e	Asset Pricing Models – Methodological Papers	9	6.2%	218
I.9	Asset Pricing Anomalies – Return Patterns Across Week/Day	4	66.7%	94
PII: 1993-1997				
N	Cluster	# Articles	Density	# Citations
II.1	Financial Intermediation/Bank Lending	6	73.3%	123
II.2	Capital Structure and Announcement Effects	5	100.0%	161
II.3a	Asset Pricing Model Anomalies – Overreaction	5	37.9%	108
II.3b	Asset Pricing Models – Multi-Factor Models	7	37.9%	211
II.4	Management Control and Turnover	5	55.0%	134
II.5	Asset Pricing Models – Macro Factors	11	35.5%	267
II.6	Asset Pricing Models	9	37.5%	237
II.7	Initial Public Offerings	15	56.2%	342
II.8a	Market Microstructure – Bid-Ask Spread	7	13.7%	182
II.8b	Market Microstructure – Dealer Behavior	9	13.7%	309
II.8c	Market Microstructure – General Patterns	9	13.7%	223
II.9	Market Microstructure – Exchange Structure and Spreads	5	60.0%	92
II.10	Term Structure of Interest Rates	5	60.0%	142
II.11	Methodological Issues	4	66.7%	187

PIII: 1998-2002				
N	Cluster	# Articles	Density	# Citations
III.1	Market Microstructure	9	25.0%	272
III.2	Financial Intermediation/Bank Lending	5	80.0%	132
III.3	Corporate Diversification and Internal Capital Markets	6	93.3%	169
III.4	Term Structure of Interest Rates	9	44.4%	237
III.5	Asset Pricing Models - Macro Factors	6	66.7%	157
III.6	Long-Term Return Anomalies	12	40.9%	414
III.7a	Asset Pricing Models	6	17.8%	215
III.7b	Asset Pricing Models - Anomalies	17	17.8%	706
III.8	Mutual Fund Performance	13	45.5%	361
III.9	Law and Finance	4	83.3%	90
III.10	Initial Public Offerings	4	83.3%	91

PIV: 2003-2007				
N	Cluster	# Articles	Density	# Citations
IV.1	Law and Finance	14	36.3%	519
IV.2	Long-Term Return Anomalies	8	35.7%	259
IV.3	Term Structure of Interest Rates	5	90.0%	144
IV.4	Capital Structure	9	33.3%	303
IV.5	Financial Intermediation/Bank Lending	6	53.3%	181
IV.6	Debt Valuation and Capital Structure	6	60.0%	160
IV.7	Corporate Diversification and Internal Capital Markets	7	81.0%	186
IV.8	Asset Valuation with Stochastic Volatility and Jumps	7	95.2%	200
IV.9	Asset Pricing Models - Macro Factors	13	25.6%	409
IV.10	Asset Pricing Models - Anomalies	15	22.4%	794
IV.11	Initial Public Offerings	16	18.8%	500
IV.12	Effects of Ownership Structure	4	100.0%	150

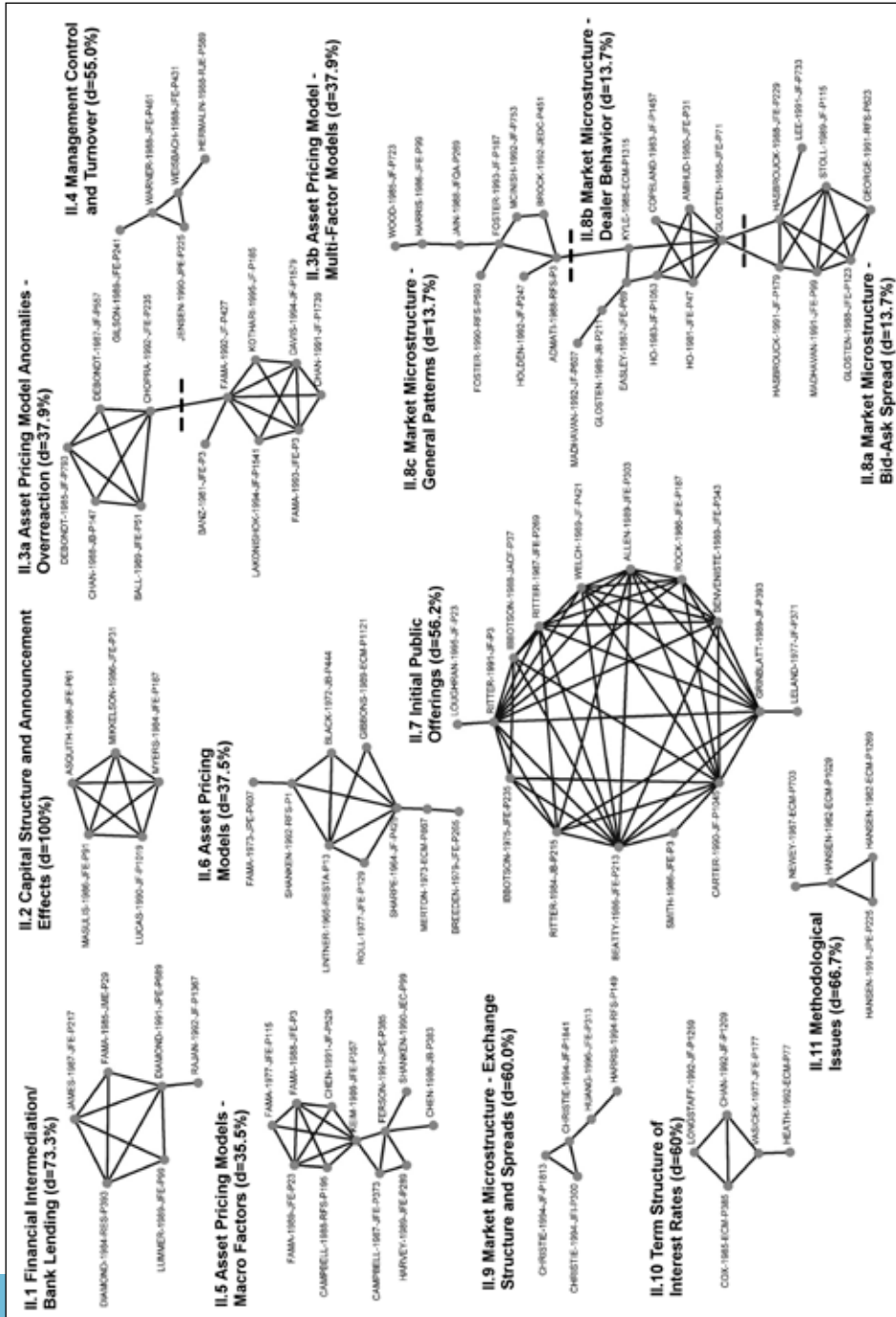
In *Annex 2*, *Cluster* gives the name of the identified cluster; *N* gives the number of the cluster (cluster identifier); *# Articles* shows the number of publications in the cluster; *Density* is the fraction of co-citation links present in relation to the possible number of co-citation links; and *# Citations* is the sum of citations to the articles in the cluster in a given period.

Annex 3: Structure of Finance Research in Period I: 1988-1992



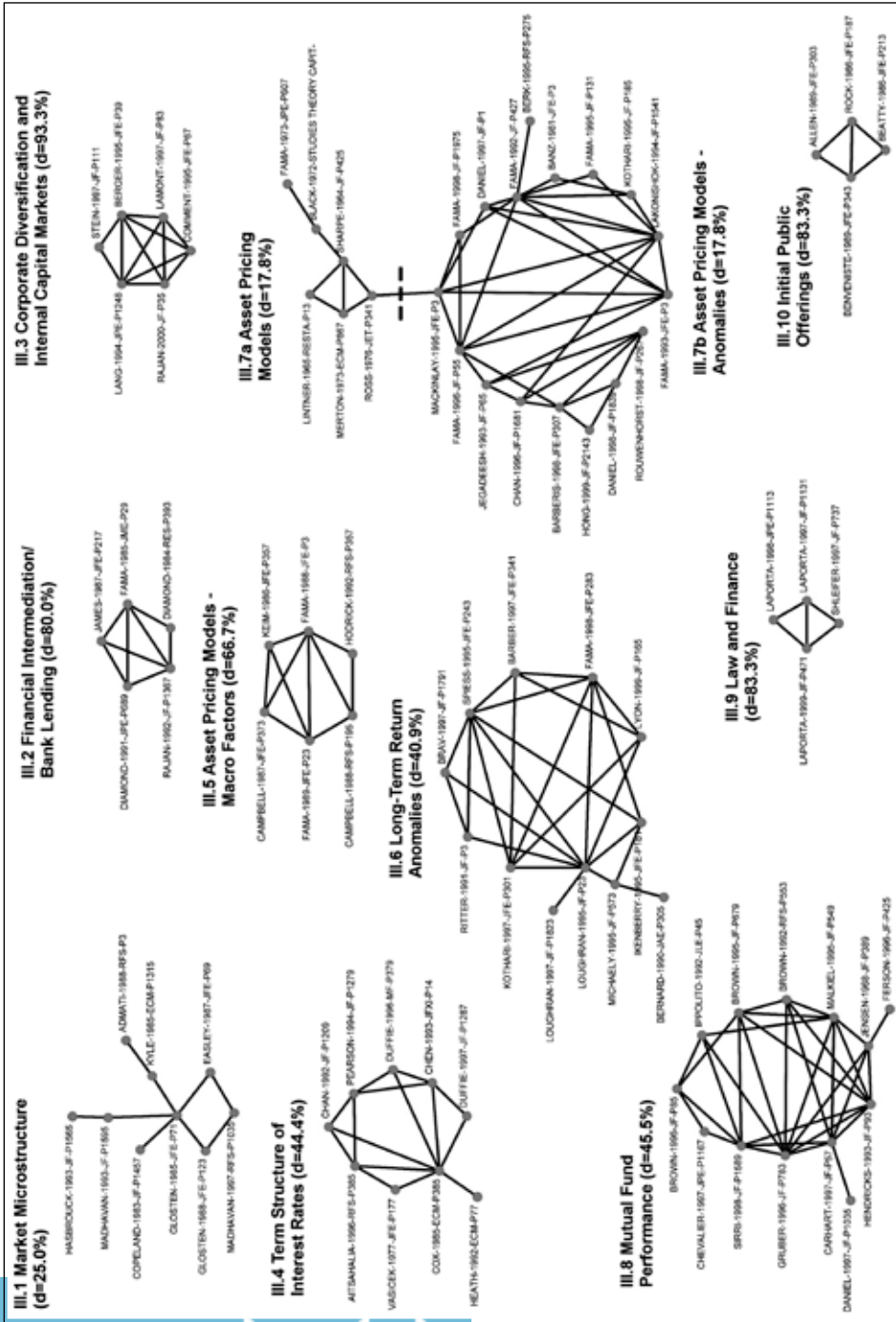
In Annex 3, each line in the display represents a Co-Citation (Co-Cit) score of more than the threshold of 0.22 between the articles; at its ends; the length of the line has no additional meaning. We exclude from the display clusters with fewer than four articles with four strong co-citation links, or clusters that create only a chain or a star of articles. The value in brackets represents the cluster density. Annex 1 provides definitions of the journal abbreviations. The dashed line delineates subclusters.

Annex 4: Structure of Finance Research in Period II: 1993-1997



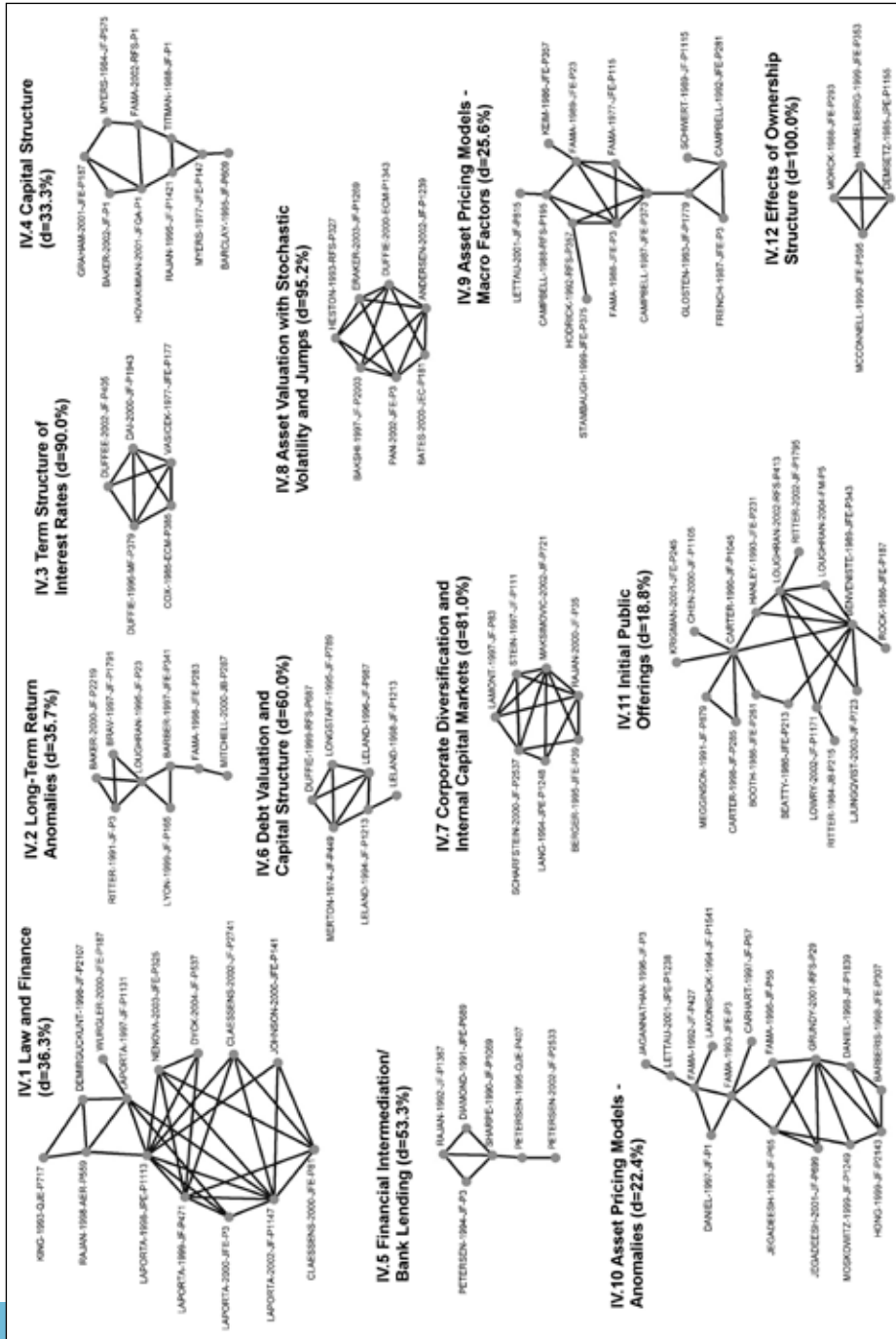
In Annex 4, each line in the display represents a Co-Citation (CoCIt) score of more than the threshold of 0.22 between the articles at its ends; the length of the line has no additional meaning. We exclude from the display clusters with fewer than four articles with four strong co-citation links, or clusters that create only a chain or a star of articles. The value in brackets represents the cluster density. Annex 7 provides definitions of the journal abbreviations. The dashed line delineates subclusters.

Annex 5: Structure of Finance Research in Period III: 1998-2002



In Annex 5, each line in the display represents a Co-Citation (CoCIt) score of more than the threshold of 0.22 between the articles at its ends; the length of the line has no additional meaning. We exclude from the display, clusters with fewer than four strong co-citation links, or clusters that create only a chain or a star of articles. The value in brackets represents the cluster density. Annex 1 provides definitions of the journal abbreviations. The dashed line delineates subclusters.

Annex 6: Structure of Finance Research in Period IV: 2003-2007



In Annex 6, each line in the display represents a Co-Citation (CoCIT) score of more than the threshold of 0.22 between the articles at its ends; the length of the line has no additional meaning. We exclude from the display clusters with fewer than four articles with four strong co-citation links, or clusters that create only a chain or a star of articles. The value in brackets represents the cluster density. Annex 1 provides definitions of the journal abbreviations.

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