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Bridging the gaping hole: central bank economists' role in the rise of macro-finance post-crisis

Abstract

How has mainstream academic economic discourse evolved to regain its epistemic authority after the financial crisis of 2008 revealed serious blind spots in economic modelling that shattered the profession's claim to be able to predict and control macroeconomic variables? To answer this question, we combine content with bibliometric analyses of nearly 70,000 papers on macroeconomics and finance published in academic journals from 1990 to 2019. These analyses reveal how a structural rapprochement between macroeconomics and finance created the new subfield of macro-finance. We show that contributions by central bank economists, driven by central banks' newly acquired macroprudential mandate, were key to its establishment. Acting within the space of regulatory science, they connected macroeconomic and financial knowledge to satisfy their employers' administrative needs, while also helping to bridge the gaping hole in economic discourse, thereby taking on an important stabilizing role for the epistemic authority of economics.

Keywords: Bibliometric Analysis; Macro-Finance; Central Banks; Cycles of Dominance; Sociology of Economics; Financial Crises.

> One can safely argue that there is a hole in our knowledge of macro financial interactions; one might also argue more controversially that economists have filled this hole with rocks as opposed to diamonds; but it is harder to argue that the hole is empty. [Reis 2018: 140]

Introduction

How did the great financial crisis influence the way the economics profession conceptualizes finance and its

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potentially disruptive impact on the macro-economy? Asking this question 15 years after the transatlantic financial crisis erupted in the summer of 2007 implies inquiring about the reflexive capacity of economics, which failed miserably in its proclaimed capacity to predict pending calamities and guide policymaking [Fligstein, Brundage and Schultz 2017].[1] To what extent has economics, which is the primary policy-guiding social science in the West, adapted to respond to this challenge to its legitimacy and fill this gap in its knowledge? In other words, how has economics as an abstract discourse evolved to incorporate the challenge of financial instability in its modelling and which agents within this intellectual field have driven this transformation in scholarship, if any? Asking these questions entails situating the evolution of economics in its real-world context and analysing the intricate relationship between policymaking and abstract discourse—in other words, between administrative interventions in the economy and theory.

The 2007–2008 financial crisis and the ensuing recession provoked a lot of soul-searching, with prominent economists attacking the profession for ignoring the risks of financial markets in their macroeconomic modelling [Krugman 2009; Kocherlakota 2010 as cited in Claessens and Kose 2018: 1].[2] Furthermore, economic scholars, in particular those involved with central bank policymaking, noted the limited usefulness of economic models for policymaking in times of financial crisis [Pagano 2014]. They linked this to a long-standing separation of macroeconomics and finance in academic discourse [Claessens and Kose 2018]. As Claessens and Kose state, the crisis revealed a fundamental gap in the available knowledge on "macrofinancial linkages", defined as "two-way interactions between the real economy and the financial sector" [*Ibid*.: V].

Critical mainstream scholars have pointed out that this lack of knowledge was due to the prevalence of the Efficient Market Hypothesis and rational expectations theory in the academic mainstream since the late 1970s [Gennaioli and Shleifer 2018; for a general exposition of the theory cf. Polillo 2015, for a critique see Fox 2009], which had led the profession to ignore these linkages, buried under the assumption that financial markets were sufficiently stable to leave them out of

[1] The public disappointment and outrage over this failure of economics is best expressed by Queen Elizabeth II asking in November 2008 why nobody saw this coming, to which the British economists could give only a tautological answer. This points to a collective lack of imagination [Bryan, Martin, and Williams 2012].

[2] A particular focus of these internal discussions was the absence of the financial sector from the dominant Dynamic Stochastic General Equilibrium (DSGE) models [for a critical view, see Stiglitz 2018; for a less negative view, see Reis 2018].

macroeconomic modelling [Claessens and Kose 2018: 64].[3] This configuration of scholarship on the macroeconomy and finance meant that when the financial sector caused unexpected macroeconomic damage during the financial crisis of 2007–2008, macroeconomic frames left policymakers largely helpless [Abolafia 2012; 2020; Fligstein, Brundage and Schultz 2017; Golub, Kaya and Reay 2015]. While the real economy was entering a dizzying tailspin in autumn 2008, central banks' macroeconomic models were still predicting an impending rapid recovery [Gennaioli and Shleifer 2018], and were unable to anticipate the unfolding crisis events and their effects.

How has the economics profession reacted to this blind spot, which challenged its claimed capacity to predict and control macroeconomic variables? And what lessons can be learned from this reaction about the general evolution of economics and its relationship to real world events? To answer these questions empirically, we undertake a quantitative content analysis, as well as a bibliometric analysis based on a dataset containing more than 69,000 papers on macroeconomics and finance published in academic journals from 1990 to 2019. Based on this analysis, we show a rapprochement between finance and macroeconomics in the wake of the crisis due to the establishment of a new subfield of economics that conceptualizes the financial system's cyclical fragilities and potential impact on the macroeconomy. We also show that economists in central banks played a crucial role in establishing this new subfield, while central banks operated as the primary initial outlets for much of the work. In this way, central bank economists became an important force in bringing about change in the economic discourse, an often overlooked effect of central banks' "scientization" [Dietsch, Claveau and Fontan 2018; Jacobs and King 2016; Marcussen 2009; 2013; Mirowski 2013; but see Claveau and Dion 2018].

Our finding, which contrasts with prior findings about the performative power of abstract academic theories on real world economies [MacKenzie and Millo 2003; MacKenzie 2006] contributes to the sociology of economics, a branch of the sociology of science that has recently made inroads into economic sociology [Van Gunten 2015; Van Gunten, Levi Martin and Misha Teplitskiy 2016]. Broadly speaking, this strand of literature argues that the evolution of economics needs to be understood in terms of the "dialectical interaction between the real world (the economy)

[3] This ignorance is linked to the micro-level foundations of macroeconomic models, which assume rational agents with complete foresight. We would like to thank one of the reviewers for this suggestion.

and the profession (economics), which claims tutelary power over it" [Fourcade 2006: 185]. One central place where this dialectical interaction plays out is in the use of economics as an abstract scientific discourse to guide the administrative craft of intervening in the economy [cf. Langley 2014; Fourcade 2009]. Whereas prior work emphasized the impact of new economic theories on administrative craft, we show that if a contradiction arises between economic events as experienced in administrative craft and the predictions of the economics profession, this dialectical tension can bring about changes in the abstract academic discourse itself.

Our study thus allows us to specify the pathways that explain the evolution of academic economics discourse post-crisis. By bringing together the political imperatives that historical events impose on policymakers with the experts tasked with addressing them (central bank economists), we show how policymakers' practical imperatives contributed to transforming macroeconomic discourse after the cataclysmic event of the financial crisis. These developments, we argue, led to a new interlinkage between previously unrelated fields of economics, namely finance and macroeconomics, thereby enabling cross-fertilization and further innovations. These developments not only exemplify the recently detected empirical turn of economics in the twenty-first century, driven by applied economists [Backhouse and Cherrier 2017], but also carry important theoretical implications for the debate on economics' continuing epistemic authority. Through their interventions in academic discourse, central bank economists ensure that it evolves in line with the imperatives of economics as a policy-guiding science, thereby contributing to its persistent "tutelary power".

To make these points, the paper proceeds as follows. In section 1, we review the literature on the evolution of economics and provide a short summary of the development of the role of finance in economics before and after the financial crisis of 2008. Here, we develop our dialectical view of economics, which evolves in the sometimes tense relationship between an abstract academic discourse and a pragmatic administrative craft of making the economy susceptible to state intervention, which can give rise to tensions that bring about change in either field. In this context, we introduce central bank economists as important actors in the evolution of economic discourse. Section 2 presents our data and discusses the combination of methods used to analyse it. Section 3 presents our findings, documenting the establishment of the subfield of macro-finance in the mainstream economic discourse, and characterizing the authors responsible for its propagation. This to an unusual degree comprises the contributions of central bank economists. Section 4

concludes by discussing the implications of our findings for the analysis of economic discourse in general and pointing to the need to give a much more prominent role to applied economists and their task environment when analysing its evolution.

Literature review

The sociology of economics is a relatively recent subfield of the sociology of knowledge, which has experienced strong development since the late 1990s [Fourcade-Gourinchas 2003], when Callon first posited the performativity hypothesis [Callon 1998]. Based on insights in science and technology studies, this thesis posited that rather than describing the economy, economics takes part in its performation by shaping and formatting it [Callon 1998: 2]. Later qualified as a process of co-performation [Callon 2007], this research investigated which socio-technical "agencements", built on economic theories, were needed to make certain economic theories succeed in the economy. In this vein, social constructivist work on the role of economics has shown that abstract economic models, such as the Black-Scholes formula, can legitimize and fuel the evolution of entire financial markets [MacKenzie and Millo 2003], as these models shape the price patterns observed in financial markets in line with their theories. This initial impulse to the sociology of economics shaped the field by leading the focus on how abstract academic theories impact the economy at large [Langley 2014: 9]. This is despite Callon's insistence on studying "economists in the wild" and their contributions to how the economy operates [1998; 2007: 336f].

This study of post-crisis change in economic discourse is based on a dialectical view of economics as a science and economics as an (administrative) practice. Following Fourcade [2006: 185], we analyse how economics claims the epistemic authority to decipher economic processes and guide administrative practices, thus ensuring the profession's "tutelary power" over the economy. However, we also emphasize that this kind of influence operates not only from academic theory towards practice, but also in the other direction. This can be derived to a considerable extent from those works in the sociology of economics that have analysed the sometimes tense relationship between abstract academic discourse and administrative economic practices [cf. Fourcade 2009; Langley 2014; on

central banking cf. Blinder 1998], as the former seeks to exert its "tutelary power" [Fourcade 2006: 185f] over the latter.

The productive tension between economics as administrative craft and as academic discipline has been pointed out by Fourcade [2009]. In her seminal work on the evolution of the discipline of economics since about 1750 she shows how government action seeking to govern the economy and innovation in economics are heavily intertwined [2009: 116]. As economists, whether within or outside government,[4] are asked to solve problems for the state, the solutions they propose in turn enter the realm of economics as a science, granting a kernel of truth to the old economists' joke that economics is the science that proves in theory what works in practice [cf. Blinder 1998: 47]. In other words, economics as a profession has often advanced through solving practical problems posed by governments or market actors [Fourcade 2009: 261], subsequently integrating these insights into academic discourse. Thus, in contrast to the predominant self-understanding of economics as an abstract science, detached from economic practice, this line maintains that much of economics' intellectual development has been driven by the economic practices of applied economists.[5]

This line of research provides strong empirical foundations over against a linear understanding of the importation of knowledge from economic theory into economic practice. However, it does not support a simple inversion of this relationship between economics as practice and economics as science [Hirschman and Berman 2014]. Instead, it conceptualizes the evolution of economics in the context of the "co-production" of both economic model worlds *and* techniques for intervention in the economy [Jasanoff 2004]. This process often occurs in the realm of "regulatory science" [Jasanoff 1990, 2011], where applied economists in administrative agencies interact with academic experts and draw upon economic knowledge to craft regulatory interventions.[6] In this vein, the

[4] Fourcade links the positioning of these economists to the historical evolution of the predominance of economic expertise in national contexts and its links to economic governance. One might add that this positioning is also cyclical with regard to economic paradigms. For example, the rise of Keynesian economics led to large numbers of economists entering government agencies [Hall 1989].

[5] In this vein, for example, the technique of linear programming, used to calculate macroeconomic models, became part of the toolkit of economics after its large-scale application in the United States during the Second World War. Similarly, game theory can be traced to efforts in cybernetics during and after the War to assess the dangers from enemies such as the Soviet Union [see Mirowski 2002].

[6] As Sheila Jasanoff [1990, 2011] points out, in this space the same epistemic standards do not apply, as the imperative for regulatory action can sometimes outweigh the imperative of absolute scientific certainty. At the same time, regulatory science also draws upon peer review and other methods of expert consultation to ensure scientific quality.

literature has documented that the economy as an object of intervention has been invented and reinvented [Mitchell 1998, 2005] by economic experts in administrative practice and in economics as a science [Breslau 1997a, b, 2003], thereby conferring legitimacy on public interventions. This sometimes tense relationship between abstract discourse and applied (administrative) intervention can bring about changes in either realm.

Most sociologists, however, still typically understand the link between these two realms of economics as a one-way street in which academic developments unilaterally drives policy shifts [Abbott 2005; Chwieroth 2010; Mudge and Vauchez 2012], transferring and applying established economic frames to local policy problems [Reay 2012]. Abbott [2005] is most explicit about this link, noting that applied economists rely on the prestige of abstract economics, but without making much use of it, a claim reinforced by Reay's [2012] empirical findings. He then theorizes that economics is imported via avatars into bureaucratic fields [cf. also Mudge and Vauchez 2012], where it slowly shifts policy paradigms [Chwieroth 2010; Kentikelennis and Babb 2019]. Such shifts are conceptualized as driven by changes in the understanding of what the state's appropriate role is in the economy. The relevant norms are conveyed and indoctrinated in university classrooms and subsequently enacted in policy circles [regarding the capacity of the neoliberal school to inculcate and promote these values, cf. Henriksen, Seabrooke and Young 2022].

In contrast, Whitley [1984] conceptualizes the influence of innovations by economists in policymaking institutions on academia. His main point is that academic and applied economists, despite their different task environments, are related in the larger intellectual field of economic knowledge production, where crucially also the latter can influence the former. In this vein, recent works show the importance of applied economists within international bodies for the evolution of the macroeconomic discourse on austerity [Ban and Patenaude 2019; Ban 2015; Clift 2018]. Similarly, Thiemann, Melches and Ibrocevic [2021] highlight the impact of central bank applied economists on the discourse about systemic risk after the crisis. This influence is built on, but notably extends beyond the creation of knowledge infrastructures, such as databases [Hirschman 2021], which applied economists not only build to inform policymaking, but also use to advance academic debates [Thiemann, Melches and Ibrocevic 2021; Thiemann 2022].

We follow the latter approach in an attempt to understand these mutual influences of applied and abstract economics. In this context

we argue the need to appreciate the dynamics of the global economics profession [Fourcade 2006], embedded as it is in the wider field of "intellectual production" of economic knowledge. To date, the literature points to the "mathematization" and ensuing globalization of economics, under a US umbrella [Fourcade 2006, 2009]. It also points to shifts in the academic field, including the synchronous ascendance of business schools and acceptance of the notion of efficient financial markets, which they invested in [Fourcade and Khurana 2013]. The sociology of economics literature, however, still largely ignores the effects of what Marcussen [2009] dubbed the "scientization of central banks", in other words, the growing employment of PhD economists in central banks, as well as their use to legitimize central bank actions and potential impact on the wider economic discourse.

Hired to engage in research that could be useful for and/or legitimize applied policymaking, these researchers exerted a remarkable impact on both macroeconomics from the 1980s onwards [Claveau and Dion 2018] and on central bank practice, influencing the way interest rates were set based on predictions of their DSGE models. Operating in the space of regulatory science situated between regulatory practice and academic theory, these economists not only transfer and apply economics to regulatory questions (as in the case of DSGE models), but, as we will seek to show, also transform regulatory questions into issues of abstract economic theory.

Evolution of the economics profession and the scientization of central banks

Since the 1960s economics has globalized in a US-centred manner [Fourcade 2006]. The field is united by mathematics, which has become the central language of economics during this period [Reay 2012; Brine and Poovey 2017]. This globalized profession defines which styles of economic reasoning are legitimate and which are not, with prestige concentrated mainly in US-based journals and departments [Fourcade 2006]. As Fourcade, Ollion and Algan [2015] show, this concentration of economic prestige went hand in hand with a particularly self-referential discourse leading up to the financial crisis, which largely ignored contributions in other social science fields.

Economics' mathematical predilection favoured the rise of finance as an ever-more important subfield in the economic discourse in the three decades before the crisis [Polillo 2020, 2015]. This coincided with the

growing prestige of business schools and their professors.[7] This rise of financial economics and business schools was the outcome of a reconfiguration in the field of economics [Fourcade and Khurana 2013], intrinsically linked to the rise of the Efficient Market Hypothesis in the 1970s [Fourcade and Khurana 2013; Polillo 2020; Whitley 1986]. Sponsored by pension funds to legitimize the expansion of capital market activities [Whitley 1986], this new discourse discarded all the elements that linked the macro-economy and finance, instead testing the strong assumption that financial markets incorporate all available information and hence allocate scarce capital efficiently [Polillo 2020; Summers 1982, 1985]. Garbed in mathematical language and using data provided by pension funds and other financial actors, financial economics established itself as a reputable subfield in economics [Fourcade and Khurana 2013], whose contributions were on the rise in mainstream journals before the crisis [Fourcade, Ollion and Algan 2015].

One unintended consequence of this rise of financial economics lay in its impact on macroeconomic reasoning. As a result of a confluence of different theorems, in particular the Modigliani-Miller theorem on capital market financing and the efficient-market hypothesis, the problems that financial markets might pose to the macroeconomy largely disappeared from macroeconomic thinking [Aglietta 2018]. the assumption of efficient capital market pricing meant that financial markets were not seen as a source of instability for the macroeconomy. This meant that they could be safely ignored in the latest type of macroeconomic models, called Real Business Cycle Models, as well as in their New Keynesian successors [Kydtland and Prescott 1977; Helgadóttir 2022, 2023]. The upshot is that these two investigative streams, macroeconomic dynamics and financial markets, diverged at this critical juncture in the late 1970s and early 1980s. Explaining this separation, Claessens and Kose [2018] write:

> The literature has exhibited an ***oscillating pattern between integration and separation of financial and real economy issues***. Early studies often considered developments in the real economy and financial sector jointly, but they resorted to mostly **qualitative approaches**. Later studies, however, emphasised the separation of the real sector from the financial sector and subscribed to the idea that the financial sector was no more than a "veil" to the real economy. […] An influential branch of the macroeconomic literature (following the real business cycle (RBC) approach) mostly focused on models that **do not account for**

[7] Fourcade *et al*. [2015: 105] also show that the contributions of business school professors rose pre-crisis [cf. also Fourcade and Khurana 2013], while the contribution of economists in government declined [cf. Mudge 2018].

financial imperfections and their potential role in shaping macrofinancial linkages [Claessens and Kose 2018: 64; *authors' emphasis*].

It was thus the highly influential Real Business Cycle Models developed by Kydlandt and Prescott [Kydtland and Prescott 1977] which drove the transformation of macroeconomics into a model world in which finance could be safely ignored [for a trenchant critique, cf. Romer 2016]. These models ended a long Keynesian tradition in which, to the contrary, finance did play an extensive role [Tobin 1981; Greenwald and Stiglitz 1993]. Because these new models were populated by single rational agents in dynamic stochastic general equilibrium [Helgadóttir 2023: 272] they had no place for the possibly disturbing impact of financial markets on the macroeconomy [cf. Brine and Poovey 2017: 288f]. Until the late 1970s, economists such as Gurley and Shaw [1955] and Tobin [1981], had emphasized the impact financial booms and busts can have on the macroeconomy. In contrast, the new rational choice models of the macroeconomy assumed that financial markets were sufficiently stable to justify safely ignoring risks of instability [Claessens and Kose 2018; Brine and Poovey 2017: 354ff].

This "divorce" manifested itself in the establishment of financial economics as a professional subdiscipline populated by, on one hand, business school professors [Khurana 2010; Fourcade and Khurana 2013; Fourcade, Ollion and Algan 2015] and on the other, New Classical and New Keynesian macroeconomics professors in university departments. This was to prove decisive both in fostering the economics profession's general incapacity to observe the build-up of systemic risks in the financial system pre-crisis and in the devastating macroeconomic consequences of their materialization. Despite the existence of some work on shocks to financial institutions that affected macroeconomic dynamics [Bernanke 1983; Bernanke and Gertler 1990],[8] generally a positive view was taken on the link between finance and the macroeconomy, linking financial deepening to economic growth [Levine 1997]. These intellectual field dynamics were aggravated by the fact that they extended beyond the purely academic realm to the field of applied economists, including those working for central banks [Claveau and Dion 2018; Marcussen 2009]. This community grew in both size and influence from the 1980s onwards, as central banks realized the symbolic and political

[8] This first wave of research focused on the direct impact of banks' balance sheets on the macroeconomy. However, it did not take a systemic view of financial system developments, for the purpose of evaluating the cyclical dynamics of the entire system, nor of the interlinkages between different market segments which could affect the macroeconomy as a whole [Claessens and Kose 2018].

capital that could be gained by rigorous economic analysis, bestowing legitimacy on monetary policy decisions domestically and increasing their epistemic authority in the increasingly international discussions of monetary policy [Fourcade 2009: 260; Johnson 2016].

In the context of this "scientization of central banks" [Marcussen 2009, 2013], central banks' increasing engagement with economics meant that they were starting to act not only as consumers, but also as producers of knowledge.[9] In this vein, Claveau and Dion [2018] show the role of central bank economists in establishing monetary economics since the 1980s as a clearly defined and high-impact disciplinary project, tracing their long-lasting and important impact in journals such as the *Journal of Money, Credit and Banking*. Central banks and their economists were key actors in the development of this field, establishing Dynamic Stochastic General Equilibrium models as the unequivocal gold standard for macroeconomic modelling. Drawing directly on Real Business Cycle Models in academic economics [Helgadóttir 2023], central bankers applied and refined these models in their daily practice, with the ECB's DSGE model being hailed by prominent academic economists as a breakthrough in modelling techniques [Mudge and Vauchez 2018: 261f]. In an ironic twist, the scientization of central banking, which led to the refinement and use of DSGE models by central banks, effectively blinded policymakers to impending developments in financial markets [Golub, Kaya and Reay 2015], as these models did not account for the possibility of large-scale problems emanating from financial markets [Stiglitz 2018].

The post-crisis situation

Post-crisis, these gaps and misconceptions of financial markets in the leading literature on macroeconomic models, as well as on financial economics led to an increasing questioning of economic expertise, both among the general public and central banks [for the Fed, cf. Abolafia 2020], in particular, simple DSGE models [Trichet 2010, as cited in Plassard 2020: 2]. This critique coincided with a political demand from the G20 in 2009 to set up a macroprudential regulatory framework [G20 2009], which would give increased importance to economic expertise in the realm of financial regulation. In this situation, central banks

[9] For a recent survey regarding the knowledge production of central banks, see Malovana *et al*. 2020.

were asked to develop a framework to detect the build up of systemic risks in order to facilitate early counteractivities with the aim of creating a more resilient financial system [Thiemann 2019], a task which risked repoliticizing their activities [Goodhart 2015].

Subsequently, research developed on financial instability [Malovana, Hodula and Rakovská 2020], including the construction of early warning systems. This was very much dominated by the need for applied economists, often operating in financial stability and/or statistics departments[10] to act on this demand, seeking confirmation of their mandate in economics [Thiemann, Melches and Ibrocevic 2021; Thiemann 2022]. This situation created a dialectical tension between economics as an administrative craft and economics as a social science. While the latter had hitherto largely ignored the dangers which could arise for the macroeconomy from financial markets,[11] the former was mandated to act on exactly these issues. To resolve this tension, central bank economists engaged in a massive research programme [Thiemann, Melches and Ibrocevic 2021]. As we will seek to show below this also had a transformative impact on the academic discourse on finance and the macroeconomy, bridging the two previously unrelated fields. Occupying central positions in the co-authorship networks that link these two fields, these authors effectively became a driving force in a process of innovation that affects both these fields.

Methods and data

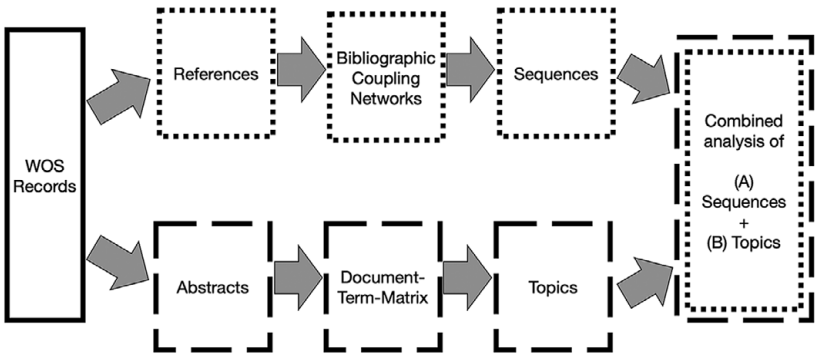
To better understand the larger impact of this work of applied central bank economists on the academic discourse on finance and the macroeconomy after the financial crisis, we investigate whether a subfield has emerged that links finance and the macroeconomy, problematizing the impact of the former on the latter. To do so, we adopt an analytical framework that combines quantitative analysis of a large corpus of economic papers written in macroeconomic and finance journals

[10] Whereas economists working in research departments often write papers for academic journals without any direct impact on central bank actions [see MUDGE and VAUCHEZ 2016, 2018], it is different for those working in financial-stability or statistics departments. Their research agendas are more constrained by the practical tasks of the department as they have to contribute directly to the institution's policy decisions [see THIEMANN 2022]. In this vein, they act as "boundarywalkers" between the realm of economics as a craft and economics as an abstract economic discourse [*Ibid*.].

[11] Heterodox economists, such as Post Keynesians, investigated these issues extensively, but their work found little attention in policy circles.

from 1990 to 2019, using text mining and bibliometric analyses with a prosopographic analysis of author CVs.[12] We thus follow prior studies of subfield emergence in macroeconomics [Claveau and Gingras 2016] which used citation data and dynamic bibliographic coupling analysis, complementing it with a topic model of article abstracts and in-depth CV data to get at the trajectories of central authors in the new subfield. Below we explain corpus construction and the analytical techniques used (see figure 0 below).

FIGURE 0
Combination of methods



For our analyses we draw on two data sources. We mainly use 69,251 bibliographic records from Web of Science and complement these with CV data obtained by web scraping.[13] We process this data by implementing a combination of Python and R code. The data basis for our analysis are the results of a search in the Web of Science database, whereby we extracted all the papers from the top 20 journals in macroeconomics and finance according to the SSCI index ranking in November 2019. We chose this list of the top 20 journals for each field to cast our net wide. As these two lists somewhat overlap, we end up with 37 journals (for a list of the journals, see Table A9). Based on this search

[12] A quantitative rather than a qualitative analysis allows us to deal with the large corpus of data. Qualitative reading of selective texts is applied to confirm the validity of and interpret the quantitative results.

[13] We additionally draw on the RePEc database to determine if and when an article has previously been published as a working paper in order to estimate the publication delay of the articles in our corpus.

we obtain 69,251 individual records.[14] In a first step, we filter these records to retain only entries that provide enough information to conduct the subsequent bibliographic analyses and the topic modelling. Because a substantial proportion of the documents in this corpus either lacks an abstract (AB field) or a list of cited references (CR field), we derive two different sub-corpora built specifically for the bibliographic network analyses (containing information in the CR field), on one hand, and for the topic modelling (containing information in the AB field), on the other. This gives us 61,115 records on which we base the subsequent topic modelling and 66,765 records that will be included in the analysis of bibliometric networks.

Topic modelling

The topic model that we construct in order to track changes in the composition of economic discourse between 1990 and 2019 is based on the article abstracts from the "AB" field in the Web of Science records. We tokenize each abstract, remove a set of stopwords and stem the data with the Natural Language Toolkit (NLTK) to obtain a document-term matrix, which contains the number of occurrences of each token in each article abstract of our corpus. Subsequently, the document-term matrix is analysed using topic modelling as implemented in Latent Dirichlet Allocation (LDA) to identify the strength of each topic in each abstract. Based on these results we can then detect both the impact of each topic on the economic discourse over time and the interrelation of different topics. Furthermore, we can subsequently conduct a cross-analysis using the results of the bibliometric network analyses described below to gain an insight into how different topics move through the bibliographic network over time.

Bibliometric analyses

The second central component of our data analysis is a bibliometric analysis to identify changes in economic discourse on a structural level. In a first step, we conduct a dynamic bibliographic coupling analysis of

[14] We observe over time a continuous and gradual increase in publications per year. The great advantage of the analytical techniques we use is that, because of their focus on relative percentages, they are mostly insensitive to this kind of continuous growth. Whenever necessary, we seek to control for secular growth trends, for example, in the case of citations, where we contrast general growth trends with the growth for our particular case (see the inter-cluster density analysis below).

time-windows of six years, followed by a comparative bibliographic coupling analysis for two time periods, namely the period until the financial crisis (1990–2007) and a period afterwards (2008–2019), identifying the formation of thematic clusters based on keywords. Bibliographic coupling operates by linking papers to each other which cite common sources, thereby identifying common fields of focus. To implement a fine-grained temporal analysis, we group the articles into overlapping time-windows with a duration of six years and construct a bibliographic coupling network for each time-window, allowing us to trace the evolution of academic discourse on a yearly basis. By moving the timeframe by one year we obtain 25 time-windows between 1990 and 2019. The nodes in each of the 25 networks represent the documents published in the six-year time span of the respective time-window, while the weight of the edges corresponds to the number of references that two articles share. We then identify partitions of articles, that is, communities with strong internal connections compared with few external ones, in the bibliographic coupling network of each time-window by drawing on the Louvain Method.[15] Finally, we compare the composition of communities in subsequent and thus partially overlapping time-windows to detect sequences of interrelated partitions.

Following the approach introduced by Claveau and Gingras [2016] we compare the composition of each partition in one time-window to each partition in the subsequent time-window. In order to do this for two partitions A in time-window T1 and partition B in time-window T2 we determine the percentage of heritable documents of partition A in time-window T1, that is, documents that are part of partition A and are also in time-window T2. If partition B in time-window T2 gets more than 65% of these documents, this partition is considered a child of partition T1 in A. If the percentage of heritable nodes that a partition B in time-window T2 receives from a partition A in time-window T1 is between 25% and 65%, the relation is treated as either a split or a merger. A value below 25% is indicative of no relation between the partitions of two adjacent time-windows. A sequence, consequently, is a series of partitions in subsequent time-windows that are children of each other by virtue of being composed of at least 65% of the same documents according to Louvain Community Detection.

[15] We use the Python package T. Aynaud. 2020. python-louvain 1.6: Louvain algorithm for community detection. https://github.com/taynaud/python-louvain. This is in turn an implementation of Vincent D. Blondel, Jean-Loup Guillaume, Renaud Lambiotte, Renaud Lefebvre (2008). Fast unfolding of communities in large networks, *Journal of Statistical Mechanics: Theory and Experiment*, 10: 10008.

We then combine the results of our topic modelling with an analysis of sequences in the bibliographic coupling networks to show which topics dominate which sequences. In addition, we engage in citation and co-authorship network analysis, as well as co-citation analysis to identify both the most cited papers and the most prominent authors in the sequences.

CV data

In a last step, we used the author information in our database and a web-scraping algorithm to download the CVs of the 40,943 authors of the overall sample. We were able to scrape the CVs of 20,643 authors, of which 3827 authors are flagged as having a central bank or an international organization in their CV. Checking the validity of the algorithm detection by hand coding a random sample of 600 authors, we find the algorithm to correctly flag central bank affiliation in 68% of the cases (compared with a rate of 32% of false positives) and to miss a central bank affiliation in 6% of cases. We decided to accept those authors who were flagged as having no affiliation and not to hand code them, but to hand code all the 3827 authors flagged as having such an affiliation. In addition, we code an additional 7124 authors whose CVs the algorithm was not able to find but whose papers have received at least one citation from papers in the corpus. Lastly, we cross-checked the accuracy of our data using the Web of Science Records, detecting central bank affiliated authors with the help of the first author column, as well as the address provided in the column address (Table A14).

Summary of our research strategy

As we investigate the changes in the discourse on macroeconomics and finance post-crisis, topic modelling allows us to see whether there is a topic on financial crises in the corpus and if so, how it evolves over time. Meanwhile, dynamic bibliographic coupling affords us the possibility of tracing the formation of subfields in the economic discourse over time in order to investigate whether a sub-field on financial crises has formed and if so, when and from what origins. With regard to whether the field of finance and the field of macroeconomics have moved closer together over time, we use the measurement of inter-cluster density between bibliographic coupling clusters; that is, we trace the number of common reference points in terms of articles that two clusters share. Here, an increase in inter-cluster density points to an intellectual "rapprochement", whose nature we can investigate by looking at the

references that contribute the most to the linkages between fields. Lastly, tracing the authorship affiliation in these sequences allows us to show which institutions were key to those interventions that ultimately restructured the field.

Findings

In the following we present our findings, moving from topic modelling results to dynamic bibliographic coupling. After discussing the overall evolution of the academic field, we investigate the content of a newly formed sequence, which from 2011 onwards explicitly treats the topic of financial instability, to then compare the distribution of central bank authors with that of other sequences. In a last step, we investigate the inter-cluster density between clusters on the macroeconomy and on finance, documenting the specific role the cluster on financial crises plays in linking the two.

Topic modelling

Applying topic modelling to the entire data set, we settled on 40 topics after a round of iterations, as 40 was the highest number of topics that did not result in "garbage" topics. This model reveals two topics with a focus on financial crises, which we named *Financial Crises Dynamics Topic*

TABLE 1
Top tokens of the financial crises topics

Financial Crises Dynamics Topic	Mortgage Credit Dynamics Topic
Bank	Debt
Financial	Credit
Crisis	Default
Market	Loan
Risk	Bond
Credit	Borrower
Capital	Risk
Liquidity	Mortgage
Banking	Spread
Asset	Rating

Note: For a full list of topics and their main tokens see Table A12.

(topic 9) and *Mortgage Credit Dynamics Topic* (topic 34], s. table 1 below).

As indicated by the tokens of these two topics, both deal with credit risks and the dynamics they can engender. The first topic on financial crises dynamics approaches the topic with a macro-lens that focuses on the banking system, liquidity risks and emergency liquidity facilities provided by central banks. It centres around the following three issues: systemic risks in banking systems, the credit supply of banking systems after financial crises, and the increasing competition banks face from shadow banks. The topic dominates papers published mainly from 2009 onwards (84 of the first 100 papers most connected to the topic were published after that date) and is predominant in articles published in finance journals, as well as the Journal of Money, Credit and Banking.

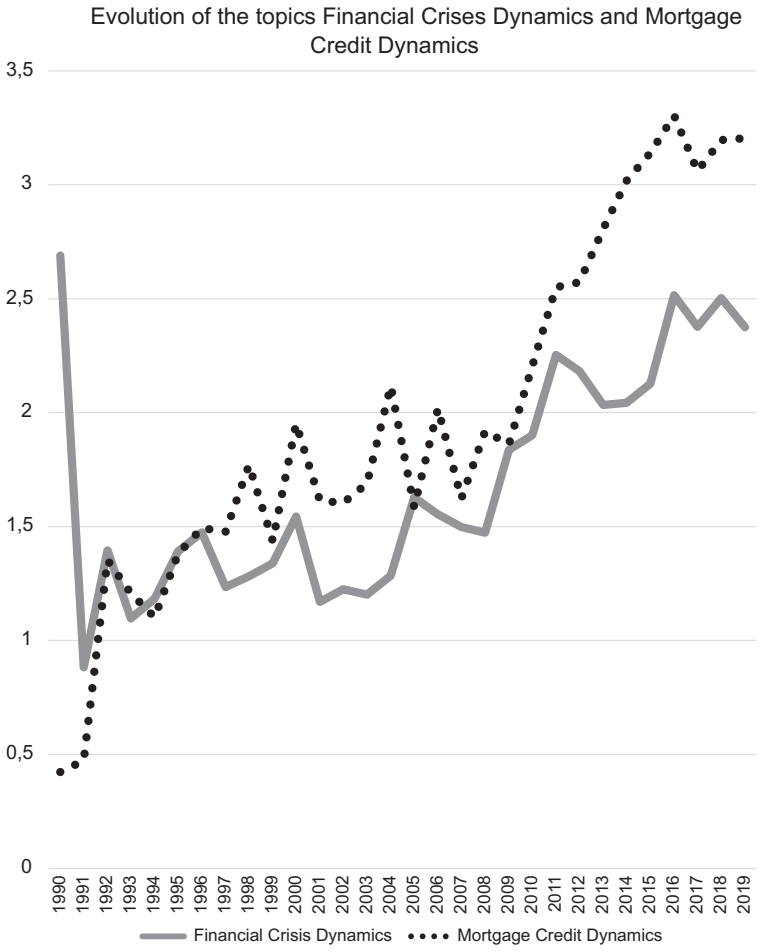
The second, more micro-economic topic focusses on the measurement (through credit ratings) and evolution of mortgage markets, individual defaults and credit risks. This topic is very much related to the particularities of the US housing market and its financial crisis dynamics of 2007–2008. Being more micro-focused and more linked to the institutional peculiarities of the US market, the topic is dominated not only by journals on finance and the Journal of Money, Credit and Banking, but also journals such as Real Estate Economics and the Journal of Accounting. The topic also reaches its peak influence a bit earlier, with 25 of the top 100 papers being published before 2009.

Below we depict the evolution of the percentages of these two topics in our corpus to show that, starting from very low levels at the beginning of the 1990s, they grew persistently over time to reach their point of maximum influence in 2016 (s. figure 1 below). In comparison, the topic Financial Crises Dynamics attains an even stronger presence post-financial crisis than the topic Mortgage Credit Dynamics.

In a next step, we select papers that score a particularly high value for at least one of these two topics and analyse their distribution over time and their authors' affiliations. Based on a cut-off value of 20%, 3888 papers in the entire corpus are strongly associated with our two focus topics. Figure 2 displays the annual percentage of papers that are dominated by one of the two topics, showing the growth of papers that are highly affiliated with the topics Financial Crises Dynamics and Mortgage Credit Dynamics from 2009 onwards. This clearly points to the importance of the financial crisis as a triggering event for such research.

When analysing the author affiliation of the papers that are strongly influenced by these two topics, we find a very strong presence of authors with a central bank background. In fact, the topic Financial Crises

FIGURE 1
Financial Crises Topics Evolution from 1990 to 2019



Dynamics is the one with the highest presence of authors with a central bank background (42%), just ahead of the topic Monetary Policy, which is followed by the topic Mortgage Credit Dynamics. The percentage of central bank authors on the latter is more than three times higher than the average of the corpus as a whole. These results underscore the strong engagement of central bank authors with these topics.

FIGURE 2
Percentage of Documents Strongly Linked to Financial Crises Topics

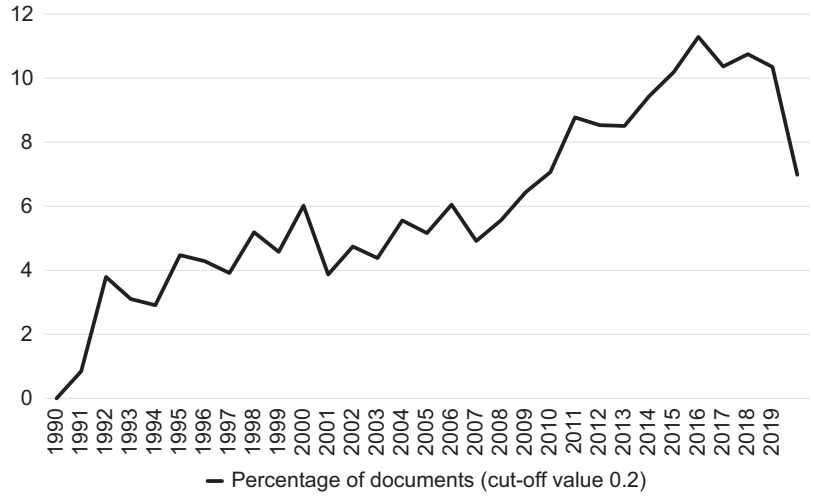


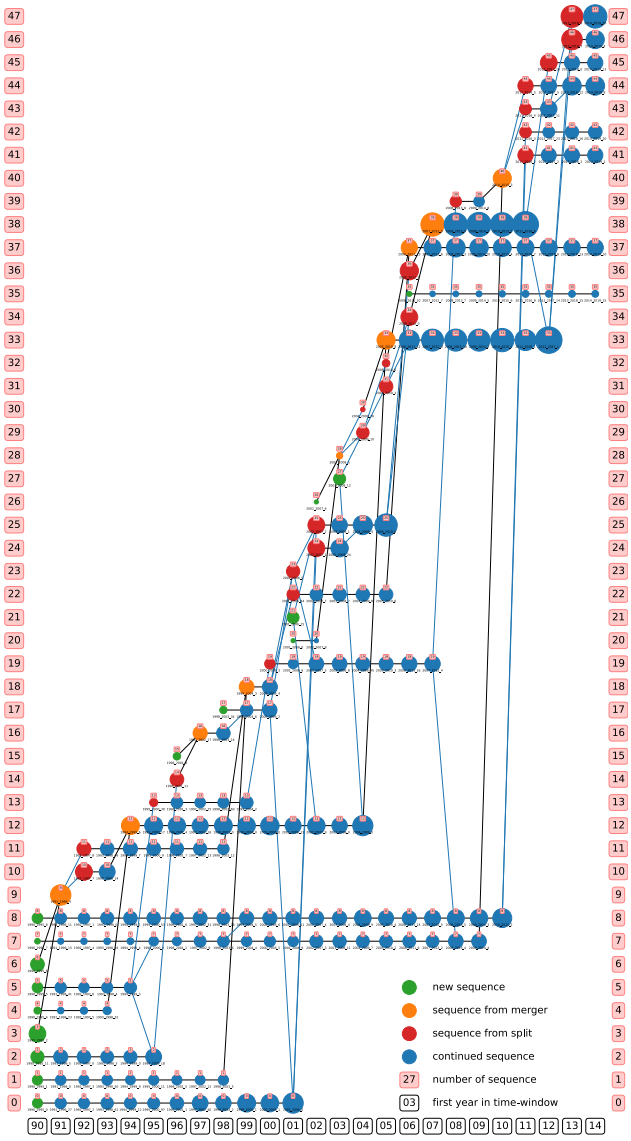
TABLE 2
Distribution of authors across topics

Focus Topic	Authors	Authors with central bank Background	Share of Authors with central bank Background
Financial Crises Dynamics	2193	920	42 %
Monetary Policy	2577	1057	41 %
Mortgage Credit Dynamics	2874	1062	37 %

Dynamic bibliographic coupling sequence analysis

The results of the topic modelling show the rising problematization of financial system properties in general and its crisis-proneness in particular. To obtain a more fine-grained understanding of the evolution of the relationship between this topic on financial crises and other themes in the dominant economic discourse, we now conduct a structural analysis to detect bibliographic clusters in our corpus. Based on our dynamic sequencing analysis, we can identify 48 sequences that last on average for about five six-year time-windows (see Figure 3). We then determine

FIGURE 3
Dynamic Sequencing Analysis



the most important keywords in each sequence to classify its content (Tables A17–A18). Finally, we analyse the composition of these sequences in terms of authorship and their changing interrelationship over time.

While several sequences are associated with either macroeconomics or finance,[16] only one sequence (sequence 42) deals predominantly with financial crises.[17] This sequence appears in the time-window 2011–2016 as a split from the sequence on financial market governance (sequence 8).[18] In line with the keywords of the financial crises sequence, the topic Financial Crises Dynamics and the topic Mortgage Credit Dynamics dominate the papers in the sequence (see Figure 4).[19]

This focus is further confirmed by a study of the 10 most cited papers in sequence 42, which all concentrate on financial crises. The first group of papers places them in a wider historical context, which sees credit cycles at play [Schularick and Taylor 2013; Reinhart and Rogoff 2011], while the second seeks to explain the dynamics of the Great Financial Crisis [Gorton and Metrick 2012; Berger and Bouwman 2013]. Other works, linked to the practical application of economic knowledge, explore measurements of risk in the banking system to predict future crises [Acemoglu *et al*. 2012; Acemoglu, Ozdaglar, and Tahbaz-Salehi 2015; Adrian and Brunnermeier 2016; Gilchrist and Zakrasiek 2012]. The last two papers seek to embed financial crises in broader macroeconomic dynamics, linking them to global capital flows [Forbes and Warnock 2012] and thus integrating them into a macroeconomic DSGE model [Brunnermeier and Sannikov 2014].[20]

[16] There is a clear line of consecutive sequences focusing on macroeconomics and monetary policy (sequence 6, 11, 18, 22, 29 and 37) and several sequences on finance. Then there are two long, highly interrelated sequences on the efficient market hypothesis (sequence 7) and on financial governance (sequence 8) that split up in 2010–2015 and 2011–2016 respectively, giving rise to several new sequences, one of which is sequence 42. There are also sequences on endogenous growth theory, game theory, econometrics, economics of education, economics of globalization and China, which we do not elaborate upon, as they do not enter into contact with macro and financial topics.

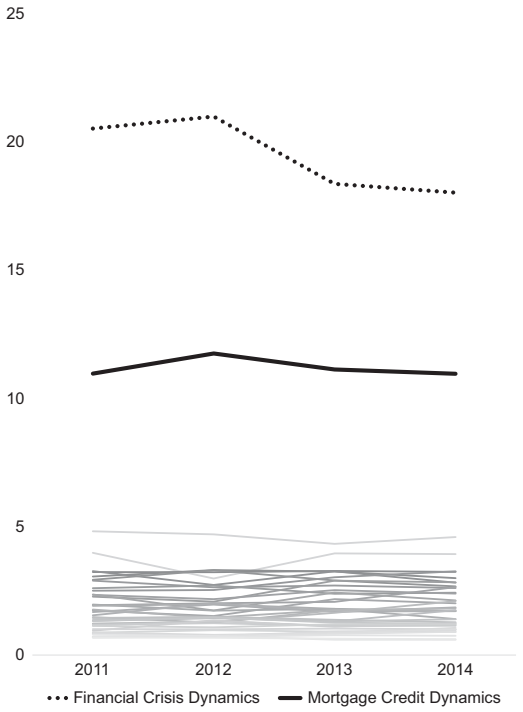
[17] The top 10 keywords of sequence 42 are financial crisis, G21 (= banks and other depository institutions), liquidity, systemic risk, monetary policy, financial crises, financial stability, banking, adverse selection, asymmetric information (Table A17).

[18] The fact that this sequence emerges only from 2011–2016 onwards can be linked to the fact that it takes several years for papers to move through the peer review process. According to the RePeC database 44% of the papers in sequence 42 were published as working papers. More than 97% of these working papers were published after 2007, indicating that the Great Financial Crisis triggered most of the work in sequence 42.

[19] Note that these topics dominate no other sequence.

[20] This focus on credit cycles and their impact on the macroeconomy is further confirmed by the papers most central in the citation network formed by papers in sequence 42. Here, the highly mathematical paper on credit cycles by Nobuhira Kiyotaki and John Moore [1997] comes first, followed by several

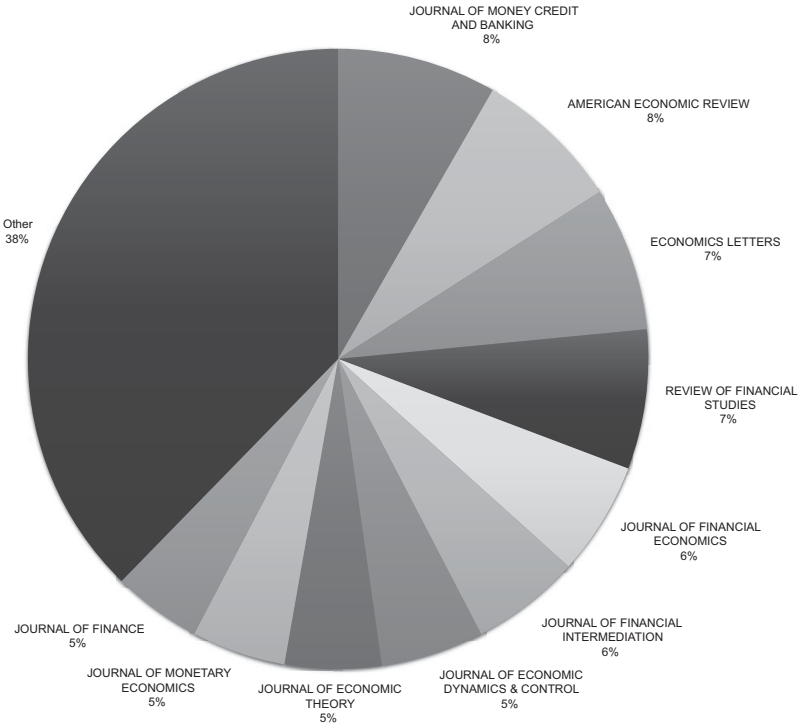
FIGURE 4
Evolution of Topics in Sequence 42



Among the various things that stand out about these top 10 cited papers of the financial crisis sequence and the sequence in general, most importantly the sequence is not confined to specialist finance journals. While the sequence does indeed have a strong presence in specialist journals, such as the Journal of Money, Credit and Banking, it also contains a high percentage of articles published in a wide array of generalist and high-impact journals (see Figure 5), such as the American

papers by Raghuram Rajan that describe the effects of close lending relationships among banks, the impact competition can have on these relationships and the dynamics linking finance and economic growth [cf. RAJAN and ZINGALES 1998]. Other papers by SHLEIFER and VISHNY [1992] and BRUNNERMEIER and PEDERSEN [2009] explore the downside risks of the credit cycle that in turn can be linked to the risk of fire sales.

FIGURE 5
Distribution of Papers across Journals in Sequence 42



Economic Review and the Review of Financial Studies (for a distribution of papers across journals in sequence 42 cf. Table A9).

A second point regarding the sequence is the prominence of central bank authors. Based on a manual inspection of the most important papers, we find that six of the top ten papers[21] and more than half of the top 100[22] papers in this sequence have at least one co-author with

[21] Two papers have authors who were working at the Federal Reserve at the time of writing. Expanding that list to people working at a central bank before they wrote their paper brings this number up to six out of the top ten papers.

[22] While 23 of the top 100 papers have at least one co-author working for a central bank at the time of publication, another 23 papers have at least one co-author who had previously worked at a central bank and 11 papers are co-authored by person with a central bank advisory role. Thus, taken together, 57 out of the top 100 papers have at least one co-author with some form of central bank affiliation.

some form of central bank affiliation. We find the same strong prevalence of authors linked to technocratic institutions when looking at the papers that are most cited by papers in sequence 42.[23] This strong presence of central bank authors among the top papers can be confirmed for the sequence on financial crises as a whole by using the author address information provided by Web of Science to identify the institutional affiliations of authors. Here, we find that more than 25% of papers in sequence 42 have at least one central bank–affiliated author. In a comparative perspective, the financial crises sequence is thereby similar to the macroeconomic sequences on monetary policy, inflation and unemployment (sequence 18, 22, 26, 32 and 37). In contrast to the high presence of central bank–affiliated authors there, the sequences on finance (sequence 7, 8, 19, 41, 43, 44) are marked by a relative low involvement of authors with institutional links (see Figure 6).[24]

The strong presence of central bank authors in both the sequence on financial crises and the sequence on macroeconomics indicates a shared concern with the tasks of modern central banks among at least some of the author population in the newly forming subfield. This formed the foundation, as we argue below, that enabled the financial crises sequence to become a central connecting sequence between the sequences on finance and the sequences on macroeconomics.

Interlinkages between the sequences in the bibliographic coupling network

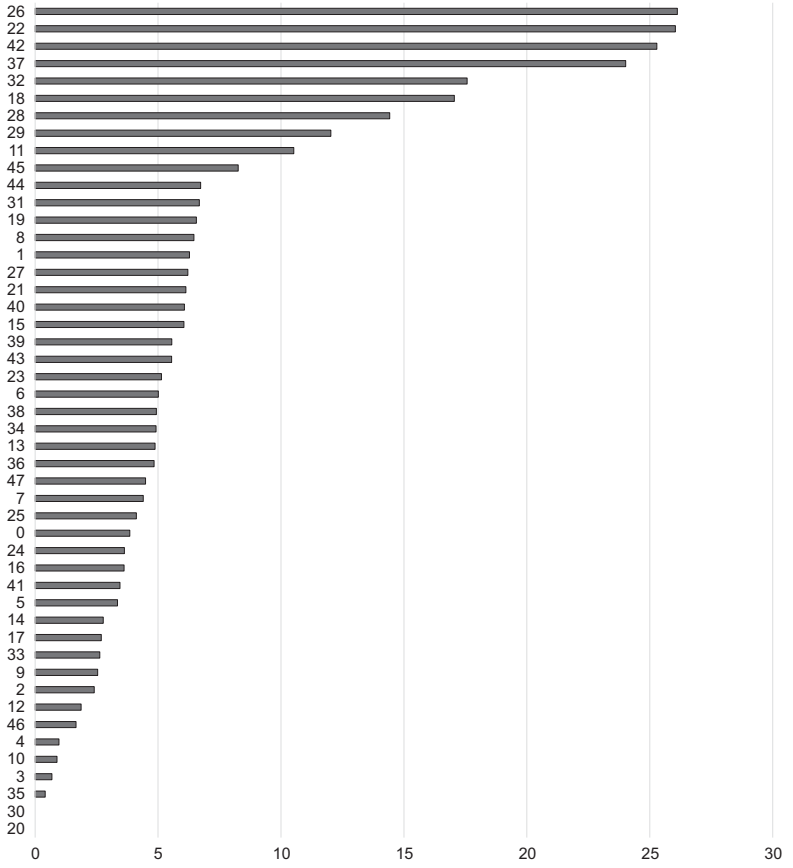
When analysing the linkages between sequences in the dynamic bibliographic coupling network, we observe generally strong links among the macroeconomic sequences (18, 22, 26, 32, 37) and among the financial sequences (7, 8, 13, 19, 41, 43, 44), but few edges connecting these two groups of sequences.[25] This structural hole between the two groups of

[23] For example, Kiyotaki, co-author of the second most cited paper of the sequence on credit cycles [Kiyotaki and Moore 1997] held a visiting position at the Fed at the time of publishing the paper.

[24] This stark difference from the other sequences on the topic of finance in terms of institutional affiliation is further revealed by a direct comparison with the top authors on the Efficient Market Hypothesis (sequence 7) with those in the financial crisis sequence. In the financial crises sequence, 60% of the top 500 authors had an institutional link to central banks and/or international organizations throughout their career, whereas only 10% of the authors of the top 500 papers in the Efficient Market Hypothesis sequence (sequence 7) had such a link. For them, the link to private sector employment, in particular in the financial sector, was much more important. As stipulated by the sociology of finance [Fourcade and Khurana 2013; MacKenzie 2006; Whitley 1986], economists working on the efficient-market hypothesis, who dominate the top publications overall, have a strong link to private finance. In contrast, those working on financial instability have a strong link to central banks and international organizations.

[25] In this vein, from 1997–2002 to 2009–2014, for 13 years, the sequence on the

FIGURE 6
Percentage of Authors with Central Bank Affiliation by Sequence



sequences is filled by the financial crises sequence (42), which connects these formerly separated fields of knowledge. This finding is vindicated by an analysis of the respective citation networks. In this vein, papers in the financial crisis sequence prominently cite papers from the

efficient market hypothesis and the sequence on financial governance (sequences 7 and 8) are the most strongly connected sequences in the whole sample. For an overview of citation patterns see Tables A2–A5.

TABLE 3
Inter-cluster density between finance and macroeconomics sequences for the time windows 2003-2008 and 2013-2018

Time Window	Sequence 1	Sequence 2	Inter-cluster Density
2003-2008	Financial Market Efficiency (7)	Macroeconomics (22)	0.0097
	Financial Market Governance (8)		0.0081
	Financial Market Volatility (19)		0.0171
	Overall Density Macro-Finance	0.0117	
2013-2018	Financial Market Governance (41)	Macroeconomics (37)	0.0081
	Financial Crises (42)		0.0280
	Financial Market Behavior (44)		0.0213
	Overall Density Macro-finance	0.0191	

macroeconomic sequence and are cited by papers from the macroeconomic sequence (Table A5).[26]

An analysis of the evolution of the inter-cluster density established between the different sequences across time-windows confirms this stronger interlinkage between papers in sequences on finance and those in sequences on macroeconomics. To illustrate this enhanced connection, we display below the results for the time-windows 2003–2008 and 2013–2018 (Table 3).[27] In the first time-window, the linkage between the three finance sequences and the macroeconomic sequence on monetary inflation and unemployment is weak, with an overall average inter-cluster density of 0.0117. In contrast, in 2013–2018, the inter-cluster density between the three finance sequences is more than 60% stronger with an increased average inter-cluster density of 0.0191. This increase can largely be accounted for by the Financial Crisis Sequence, whose inter-cluster density with the Macroeconomic Sequence in turn is more than 40% higher than the overall new average.

This comparatively high inter-cluster density between the sequences on financial crises (42) and on macroeconomics (37) is undergirded by the fact that they have the highest percentage of shared authors of all sequences: 23% of the authors in the macroeconomics sequence (37) have

[26] This strong linkage between the sequences on macroeconomics and financial crises post-crisis is furthermore supported by the overlap of papers which form part of both the macroeconomic sequence and the financial crises topic over the different time-windows. More than 18% of papers that were assigned to the financial crisis sequence at least once were also assigned to the sequence on macroeconomics, the highest value of any finance sequence in terms of papers being cross listed in a sequence on macroeconomics.

[27] This selection assumes that papers on the Great Financial Crisis were only published from 2009 onwards.

published at least one paper in the financial crisis sequence (42), a finding which is even more pronounced for central bank authors. While 34% of central bank authors have published in the macroeconomic sequence 37% have also published in sequence 42 on financial crises. This finding strongly suggests that the linkage between the sequences on financial crises and on macroeconomics is strongly supported by central bank authors' active contributions in both sequences and by the strong presence of central bank authors in general.[28] The centrality of central bank–affiliated authors in this literature is further confirmed when analysing the co-authorship network formed by the 8009 authors publishing in sequence 42. In the largest subcomponent of that network, 21.7% of authors with a central bank affiliation have on average 50% more edges than the average author, and their eigenvector centrality measure[29] is more than twice as high (cf. Table A19).

Our analysis below seeks to further analyse these overall shifts in the discourse on macroeconomics and finance from pre- to post-crisis by comparing the two respective bibliographic coupling networks (1990–2007 vs 2008–2019). Here, once more, the bridging function of the papers on financial crises, connecting the discourse on finance and the macro-economy can be confirmed. This establishes a new perception of the macroeconomic dangers inherent in financial markets. We also show the crucial role of central bank authors in creating this bridge.

Bibliographic coupling network analysis for the periods 1990–2007 and 2008–2019

The dynamic bibliographic coupling analysis above shows the emergence of a sequence on financial crises in 2011 that acts as a bridge between the formerly separated sequences on finance and macroeconomics. To capture the cumulative extent of this larger shift linking finance and macroeconomics over time, we conduct an additional static bibliographic coupling network analysis, comparing the periods before 1990–2007 and after 2008–2019 (the financial crisis). For each period, we identify the largest component of the bibliographical coupling network and, using the Louvain algorithm, its internal clusters. We then proceed to establish the

[28] In this vein, the results reported in Table A16 show that papers by central bank authors, in particular those publishing in both sequences, generate a much higher number of edges between these two sequences than the average paper.

[29] Eigenvector centrality measures not only authors' connectedness, but also the number of edges of the authors to whom they are connected. This means that central bank authors are well connected to authors who are well connected.

relevant clusters for our analysis using the dominant keywords per cluster, a reading of the abstracts of the most important papers, as well as the membership of papers in the sequences identified in the dynamic sequencing analysis described above.

Using this approach, we identify four clusters of relevance for the first period (1990–2007), three of which are on finance and one on macroeconomics. Two of the clusters on finance cover the efficient market hypothesis and financial market governance respectively, which have little or no relationship with macroeconomics.[30] This limited quantitative engagement of finance with macroeconomics, based on qualitative approaches according to which one could safely be neglected in terms of the other, changed for the period 2008–2019, in which a much stronger relationship may be discerned.

In the bibliographic coupling network from 2008 to 2019, there are altogether three clusters of relevance: one on financial governance and macro-finance, which now also includes a strong component of papers from the sequence on financial crises (42); one on financial market behaviour, which brings together work on efficient markets and financial market volatility; and one on macroeconomics, which now also includes a component of papers from sequence 42 on financial crises. The cluster on financial governance and macro-finance and the pure cluster on financial market behaviour have a much stronger bibliographic coupling relation with macroeconomics than the clusters on finance before the crisis. The average density is almost twice as high for both clusters (Table 4).[31]

To explain the factors driving this difference in connections between the clusters over time, we investigate the contribution made by the presence and connecting role of papers on financial crises during these two periods. Drawing on all the papers identified in the topic modelling, which indicate a high membership for the topic on financial crises dynamics in both time periods, we first identify a much greater presence

[30] The cluster covering the relationship between volatility/option pricing and macroeconomics, in contrast, is twice as strong (Table 4). These linkages are created primarily through papers that reference Real Business Cycle Theory, for example, by Robert Lucas [1975] and Finn Kydtland and Edward Prescott [1977]. These account for the majority of bibliographic coupling edges created between these clusters (for the list of top ten papers creating these linkages, see Tables A10–A12).

[31] As we will show, this result is driven primarily by the increasing percentage of papers on financial crises and not by a general trend of rising citations, as a closer analysis of the two sub-networks reveals. While research suggests that the general number of citations has been rising since 2005 because of the increasing use of the internet [Evans and Reimer 2009, which might explain part of this increasing inter-cluster density, it should be noted that the main density of the overall main component for these two networks only rises by 50%. In contrast, the density between the clusters on finance and the one on the macroeconomy almost doubles.

TABLE 4
Interrelations of the cluster of macroeconomics

Interrelations of the Cluster on Macroeconomics with…	Inter-cluster Density
Relevant clusters in network 1990-2007	
Financial Governance	0.007
Finance (EMH)	0.006
Finance (volatility and option pricing)	0.013
Relevant clusters in network 2008-2019	
Financial Governance and Macro-finance	0.013
Financial markets behavior	0.019

TABLE 5
The changing share of financial crises papers[1]

Cluster	Share of Financial Crisis Papers
1990-2007	
Macroeconomics	1.0 %
Financial Governance	14.0 %
Finance (EMH)	1.0 %
Finance (volatility and option pricing)	5.0 %
2008-2019	
Macroeconomics	9.0 %
Financial Governance	31.0 %
Finance (merging EMH and volatility and option pricing)	7 %

[1] The table compares the share of financial crisis papers in the clusters in 1990-2007 and 2008-2019. We define financial crisis papers as those documents that have a more than 20% attribution to one of the financial crises topics.

of papers on financial crises in the clusters on macroeconomics and on finance from 2008 onwards (Table 5).

In a second step, we investigate the contribution of these papers on financial crises to the creation of links between the macroeconomics and finance clusters. Here we find that in both periods these papers, on average, created a higher number of links than the average paper in these clusters. Their contribution in the period 2008–2019 was particularly strong (Table A7 and A8).[32]

[32] During this second period, papers on financial crises in the finance clusters create, on average and respectively, 54% (financial governance) and 31% (finance) more bibliographic coupling links with papers in the macroeconomic cluster than the average paper

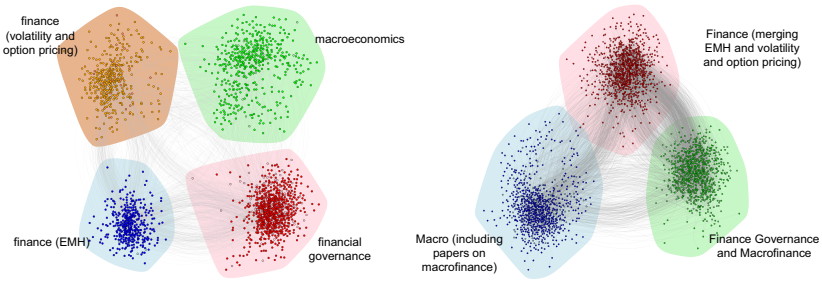
Figure 7 depicts these increasing linkages between finance and macroeconomic clusters over time, while Figure 8 shows the central role of papers strongly shaped by topics on financial crises within each cluster to the creation of these linkages.[33]

As Figure 7 illustrates, the two clusters on finance in the period 2008–2019 have a much stronger connection to the cluster on macroeconomics (blue) than the clusters on finance have to macroeconomics (green) in the period 1990–2007. Figure 8 depicts the contribution from papers on financial crisis to this increasing connection; the link between the clusters on financial governance, macro-finance and macroeconomics is driven primarily by the papers on financial crises (Figure 8, right-hand side), clarifying the central focus of this linkage. In contrast, this connection created by financial crises papers between financial governance and macroeconomics is much weaker pre-crisis (cf. Figure 8, left-hand side).

These changes in cluster connectivity go hand in hand with a rising contribution to these clusters by central bank authors: their presence in these clusters almost doubled from 1990–2007 to 2008–2019.[34] Their central role in these clusters, in particular with regard to the papers on

FIGURE 7

Evolution of the Relationship between the Macroeconomic and Finance Clusters

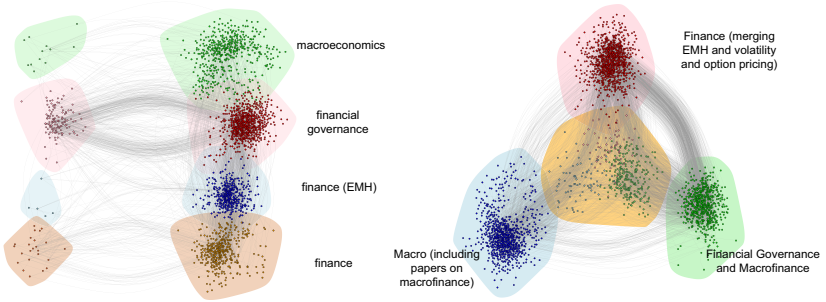


in their respective clusters. This central role of crisis papers is even more pronounced in the macroeconomics cluster: these papers have three times as many links with papers on financial governance than the average macroeconomics paper (Table A8).

[33] The figures show 1990–2007 on the left and 2008–2019 on the right. To improve the readability of the graphs without distorting the results the figures display only 20% of the nodes and 3% of the edges of each network.

[34] The percentage rises from 23% to 40% for the macroeconomic cluster; from 10% to 17% for the financial governance cluster; and from 7% to 13% for the financial market cluster.

FIGURE 8
The Role of Papers on Financial Crises in the Evolution of the Relationship between the Macroeconomics and Finance Clusters



financial crises (cf. Table 2) suggests that central bank economists were important actors in enhancing the linkage of these clusters, bridging the gap between them.

Conclusion: the role of central bank economists in the reintegration of the topic of financial instability in macroeconomic discourse

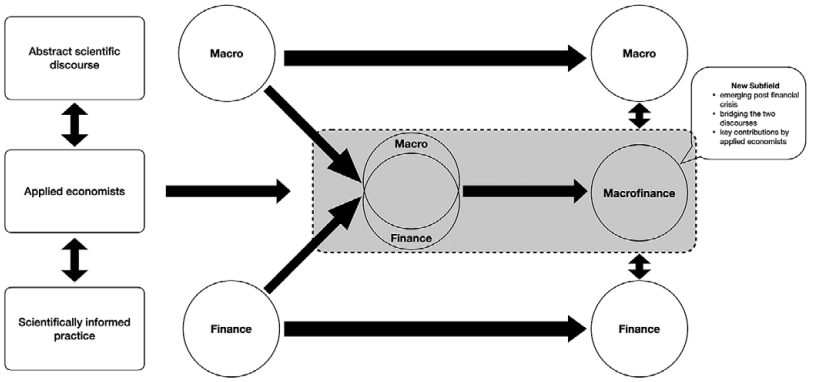
This paper set out to investigate the impact of the financial crisis on scholarly discourse on macroeconomics and finance by analysing the complete corpus of papers published in the top economics and finance journals from 1990 to 2019. To do so, it combined dynamic bibliometric analyses of publication patterns with a topic modelling analysis to trace the evolution of themes and paradigms. Using this approach we identified two topics—one on financial crises dynamics and one on mortgage credit dynamics—that document the rising importance of the theme of financial crises and their macroeconomic consequences. Both topics became particularly important after 2007, reflected in the fact that about two-thirds of the papers published from 2008 onwards are closely related. These results show the responsiveness of the economics profession to the financial crisis of 2007–2008.

Using bibliographic sequencing analysis, we were then able to identify the emergence of a sequence on financial crises dynamics and the relevant impact on the macroeconomy from the time-window 2011–2016

onwards (sequence 42). This sequence of papers focuses on financial crises and systemic risk and links them to monetary policy. It emerges from the sequence focusing on financial governance, which from 2010 onwards split into several clusters, while also integrating important new elements. The most notable finding from the analysis of this corpus is that authors affiliated to central banks are strongly present, only matched by the sequence of papers developing macroeconomic models for central banks for monetary policymaking. This finding shows that central bank economists have become a driving force in the evolution of academic economic discourse since the financial crisis, reflecting on and integrating experience of the financial crisis in abstract economic reasoning (cf. Figure 9).

In a next step, we showed that this cluster of papers was important in forging a link between the discourses on macroeconomics and finance, which did not exist before the financial crisis. In this vein, the paper documents the rise to prominence of a view that sees finance as operating in credit cycles, representing a potentially destabilizing macroeconomic factor post-crisis. This new view, which bridges these two discourses, has been carried forward by an alliance of central bank and academic economists, pushing publications tackling this new view into the top economic journals. These papers examine "macro-financial linkages" [Claessens and Kose 2018; Cochrane 2017] through which fragile financial systems can bring about severe recession, as happened as a result of the Great Financial Crisis

FIGURE 9
The Rise of Macro-Finance and the Role of Applied Economists



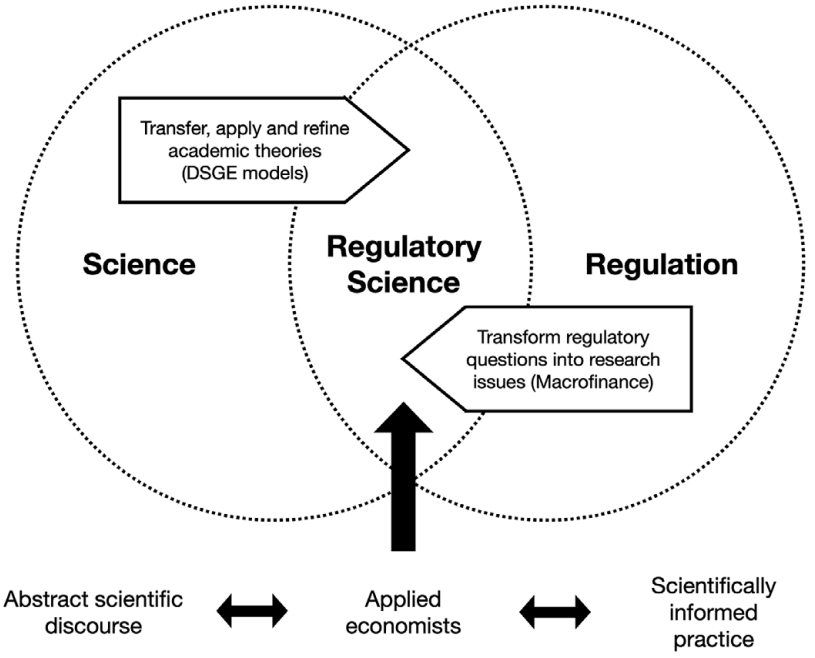
of 2008. They are in part the outcome of reflections by central bank economists charged with surveilling financial vulnerabilities and their potential impact on the macro-economy [cf. Adrian, Covitz and Liang 2013; Adrian, Boyarchenko and Giannone 2016]. This task was added to the duties of central banks in the wake of the financial crisis. As institutional actors, central banks facilitated this bridging across domains by bringing together economists working on macroeconomics with those working on finance, often mandating them to work on the topic jointly [cf. Thiemann 2022].

This research validates the notion of a dialectical relationship between economics and the economy, as proposed by scholars such as Fourcade [2006, 2009]. This finds expression in the craft of economic governance and administration and can have a formative impact on abstract economic science. But it also provides more empirical insights into the mechanisms that drive this influence from theory to practice and from practice to theory. In this connection, the study points first to the ability of applied economists, situated between scholarly informed practice and abstract scholarly discourse in the space of regulatory science, to bridge different subfields in order to address their particular area of interest. These areas of interest are not driven primarily by academic incentives, but by the interests of their employer, central banks. They thus assume a bridging role, making important contributions to the literature in both finance and macroeconomics, producing innovations in each of them in turn.

In a longer term perspective, these research findings point to two different dynamics that characterize the work of applied economists in the realm of regulatory science, where they mediate between abstract academic discourses and administrative craft (cf. Figure 10). Abstract academic discourse on finance and the macroeconomy first came to dominate the wider intellectual field of economics and the craft of administration in the 1980s, ousting practical knowledge of finance's cyclical dangers to the macroeconomy.[35] Central bank economists applied New Keynesian DSGE models to their task of making economic predictions, adapting the model to their data and thereby refining academic modelling techniques [Mudge and Vauchez 2018]. As a result of this incorporation of academic models in their work the craft of governing the economy was sidelined and financial market developments were

[35] For an analysis of the administrative and organizational redesign within central banks that resulted in the imposition of abstract economic knowledge and the loss of practical knowledge, see Wansleben 2021.

FIGURE 10
The Work of Applied Economists



ignored. As a consequence, economic governance was severely disrupted by events it did not anticipate.

Subsequently, the need to restore economic governance shaped the evolution of abstract scholarly discourse as efforts were made to re-insert an understanding of the dangers of finance to the macroeconomy into economic discourse. In this sense, the financial crisis functioned as a quasi-natural experiment, giving rise to work on the links between the macroeconomy and the financial system, focusing on the potentially destabilising dynamics within the financial sector and their impact on the macroeconomy. This question was not posed merely as an academic exercise, although the fact that outlets for such work increasingly became available made it particularly appealing to academics. It also arose as an administrative issue, in terms of the monitoring and supervision of the financial system with a view to preventing system-wide disruptions that could threaten the macroeconomy. This task fell primarily to central

banks, which tasked their staff to conduct analytic studies of these relationships, based on new datasets built explicitly for that purpose [Thiemann 2022]. Lacking ready-made models in terms of which they could comprehend these linkages between the macroeconomy and finance, central bank economists became an important force of innovation, introducing the linkages into work on both macroeconomic dynamics and finance. This in turn contributed to the creation of a new interlinkage between macroeconomics and finance in academic discourse, where previously there had been a gaping "hole" [Reis 2018: 140].

In this way, the financial crisis disrupted a self-referential academic discourse largely centred around professional interests and notions of academic elegance in mathematical modelling [Helgadóttir 2022], and opened up a path towards a discourse that is more other-referential and more attuned to developments in the wider intellectual field and the realm of economic administration [Thiemann 2022]. Our analysis points to a central role of central bank economists as mediators of this dynamic, in both macroeconomics and finance. Applied economists in central banks were tasked post-crisis with developing tools to manage financial stability (such as early warning systems to detect the build-up of systemic riscks). They therefore engaged in a large-scale research programme, allying with academic economists to generate stylized facts about the relationship between finance and the macroeconomy that could justify their interventions [Thiemann 2022; for the general concept of stylized facts, see Hirschman 2016, 2021]. They sought to link these findings to their colleagues' research on macroeconomics and the tools developed there to manage the macroeconomy. As a result, this group exerted substantial influence on the scholarly discourse on macro-finance, which in turn was shaped by the interests and pre-occupations of central banks.

This finding is of crucial importance for the economics profession's ability to continue to claim a tutelary power over the economy [Fourcade 2006] in the face of events that seem to contradict its main tenets. As a social system, academic economic discourse combines self- with other-referentiality [Luhmann 1995]. Like any other social system, it can exhibit a tendency to follow an internal path-dependent logic encompassing certain assumptions, methodological decisions and modelling techniques [Cherrier 2023], which exclude certain phenomena from view. Consequently, it might experience serious deviations from what it expects within the framework of its established mode of observation, giving rise to a crisis in economics' epistemic authority as a policy-guiding science. Applied economists then endeavour to recalibrate academic discourse by increasing its other-referentiality in relation to real

world events. By helping economics to make sense of such events, they enable it to adjust to them and to develop appropriate administrative practices to cope. Applied economists, from their position within regulatory space, are thus able to bring about crucial adjustments in scholarly economic discourse, enabling it to maintain its legitimacy as a guide to policymaking.

Applied economists, as we have suggested, play an important role in enabling economic discourse to maintain its claim of tutelary power over the economy. This role is much more important than the one envisaged by the previous conceptualization of the relationship between abstract scientific discourse and applied policy. The nature of applied economists' career interests and how they shape and bias central bank economists' work remains an important research topic, as the structural position of these economists within institutions inevitably influences their blind spots [for a critical take, see Gabor 2020]. [36] Future research can look more deeply into the extent to which the two research programmes—on macroeconomics and monetary policy pushing DSGE models and on financial instability—have become interlinked [for a sceptical view, see Helgadóttir and Ban 2021]. Has economics achieved some sort of equilibrium after the polarization that led to the emergence of the new field [Van Gunten 2015]? To what extent has work on financial instability become an "obligatory passage point" [Latour 1999] for monetary policy models? Did these efforts lead to a fusion of these two governance programmes in practice or are central bankers still implementing monetary policy without considering financial stability, ignoring finance despite all the risks?

Besides financial stability and macro-finance, this finding of the enhanced role of applied economists in policymaking institutions in relation to abstract economic discourse opens up many new avenues for research. The crucial question is when and under what conditions we are likely to see such increased influence. Cataclysmic real world events that call existing paradigms into question, such as the financial crisis, seem to be necessary. These events enhance academic discourse's other-referentiality, in other words its openness to "real world events". This, combined with applied economists' research advantages because of their preferential access to data and organizational imperative to study these

[36] This question seems particularly apt in relation to work on macro-finance and the role central banks themselves might play in generating financial instability. Are central bank economists able to reflect on this issue? Recent work on central bank research on QE suggests that the issue of self-reflexivity and blame avoidance has shaped central banks' work on the effects of QE [Fabo *et al*. 2020].

issues, at least partially explains their newfound importance. These advantages are not shared by academic economists, who face a different incentive set and can suffer from a certain inertia linked to established research traditions and the need to build up a body of publications. While academic economists can avoid the study of real world events, applied economists are under direct pressure from superiors to produce knowledge on these issues [Whitley 1984]. The structural resources available to applied economists also play an important role. In our case, central bank economists' research efforts were facilitated not only by the increased urgency of central banks' new financial stability mandate, but also by the increased resources central banks were able to provide as a result of increased revenues originating from quantitative easing.

Such incentives and enhanced resources are also found in other research areas, where academic discourse and policymaking have entered into a dialectical relationship within the framework of what is called "regulatory science" [Jasanoff 2011]. One might point here to the massive research budgets of regulatory agencies such as the FDA [Jasanoff 1990], which hire health economists to engage in cost-benefit analysis; applied economists involved in market design for electricity markets, for example, in the European Commission [Reverdy and Breslau 2019; see also Rilinger 2022]; as well as applied economists working for securities market regulators. Seeking to justify new regulation (for example, of drug pricing, electricity markets or securities markets) in the wake of scandals, such as those involving the production of insulin, volatile energy market pricing practices and unexpected financial market volatility, applied economists have both the incentives and the wherewithal to conduct this kind of research. One might also point to the work of economists working for competition authorities in recent attempts to break up and limit tech giants, such as Google or Meta in the United States or the EU. While the Chicago School's understanding of competition as applied in competition law sees little justification for undertaking such break-ups [Davies 2010], recent regulatory initiatives have drawn on alternative economic theories to justify such interventions [for example, Lau 2020].

Supplementary Material

To view supplementary material for this article, please visit http://doi.org/10.1017/S0003975623000516.

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