

**Dealing with Uncertainty:  
A Historical Sociology of Evaluation Practices  
in UK Life Insurance, 1971-Present**

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# Declaration

I declare that this thesis was composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where stated otherwise by reference or acknowledgement, the work presented is entirely my own.

Signed,

Arjen Wytse van der Heide

Place and date:

Edinburgh, June 3, 2019



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# Lay Summary

In this dissertation, I investigate the evolution of the methods and techniques through which UK life insurers calculate the economic worth of insurance contracts. The dissertation takes a historical perspective and examines how the calculative practices of life insurers have changed since 1971. Specifically, it focuses on how the emergence of novel practices of calculation shaped and was shaped by the broader context of UK life insurance.

Life insurance typically involves the purchase of protection against the financial consequences of early death or, in the case of pensions, of long-lasting lives. Using their knowledge of mortality statistics, actuaries would calculate policyholders' risk of dying; they then used those calculations to evaluate the economic worth of a given 'promise' (e.g. a pre-specified lump sum when the insured individual dies). To deal with uncertainty around the accuracy of their calculations, actuaries applied the principle of prudence – that is, they incorporated implicit margins in their calculations that would allow their expectations to be some way off the mark without leading to large losses for the insurer. Actuaries, moreover, were responsible for distributing the often large financial surpluses thus accumulated across different groups of policyholders and, in the case of proprietary companies, shareholders. Actuaries, in other words, were the 'custodians of surplus'.

Since the early 1970s, however, insurers have increasingly sought to calculate new types of risk, different from traditional insurance risks such as mortality. This includes most notably, though not exclusively, financial risk – the risk that insurers' investments generate less income than initially expected. Rather than dealing with this form of uncertainty through implicit margins, insurers started modelling financial markets to quantify *how* uncertain their returns on investments actually were and what level of reserves they needed to avoid economic catastrophe, reducing the role of 'actuarial prudence'. Particularly important was the introduction of techniques from modern financial economics, techniques that up until the early 2000s were relatively foreign to the world of insurance.

In this study, I investigate the often subterranean but sometimes rather overt conflicts and tensions between different traditions of evaluation that thus emerged. I find that the changes in insurers' calculative practices were intricately entangled with broader developments in life insurance. On the one hand, the introduction of the novel calculative techniques was facilitated by a decline in the authority of actuarial expertise, by competition among insurers, and by regulatory reform. On the other hand, the introduction of these techniques contributed to changes in the structure of contemporary life insurance arrangements, increasingly pushing the burden of financial risk to the level of the individual policyholder, and turning actuaries into technical experts rather than custodians of surplus. To understand how and why these changes came about, I argue, it is necessary to consider how the new techniques were used as strategic resources in the competitive struggles of companies in the market for life insurance.



# Abstract

This dissertation examines the evolution of UK life insurance arrangements by investigating how the ways in which life insurers evaluate the economic worth of insurance contracts have changed since the early 1970s. It draws on a set of 44 oral-history interviews, supplemented by an extensive set of documents, to describe how, in addition to traditional forms of ‘diversifiable’ insurance risk, insurers have increasingly sought to quantify forms of ‘non-diversifiable’ risk such as financial market risk. The central question is how changes in insurers’ evaluation practices shaped and were shaped by broader developments in UK life insurance.

In addressing this question, the dissertation combines insights from field-theoretical perspectives in ‘conventional’ economic sociology, the recent literature on the performativity of economics, the sociology of insurance and the sociology of scientific knowledge. Field theory is a useful tool for understanding how meso-level social orders emerge as a function of the strategic behaviour of actors in social domains such as markets. The assumption of ‘technological determinism’ prevalent in field-theoretical perspectives, however, conflicts with insights from the sociology of scientific knowledge and recent literature on the performativity of economics. This tension may be alleviated, I argue, by conceptualising both the market for life insurance and actuarial science as fields (a ‘market field’ and an ‘epistemic field’) and by investigating the interrelations between the two.

In deploying this field-theoretical perspective, the dissertation finds, on the one hand, that developments in the market field may lead to new opportunities and challenges in the epistemic field. Particularly important in the epistemic field, for instance, was the ascendancy of modern finance theory’s no-arbitrage models as key exemplars for the modelling of insurance liabilities in actuarial science. However, only when the jurisdictional claims of the actuarial profession were threatened and when supervisors required insurers to evaluate their liabilities using techniques already used in banking did these models become dominant in the actuarial field.

On the other hand, I argue that the ways in which life insurers evaluate the economic worth of insurance contracts matters for what life insurance is and does. Evaluations of ‘value’ and ‘risk’ inform decision making about the distribution of financial surplus and risk across different groups of policyholders and shareholders, the types of products that life insurers choose to underwrite, and the way in which they invest their assets in capital markets. Since the 1970s, the emergence of novel evaluation practices has contributed to the individualisation of financial risk in insurance arrangements, a shift in insurers’ asset allocations from equities to fixed-income investments, and a declining willingness from insurers to underwrite traditional mortality-related risks. The business of life insurance, in other words, increasingly revolves around investment intermediation rather than protection.

The findings of this dissertation draw attention to the politics of seemingly technical issues such as the discounting of future cash flows to present values. Overall, I suggest that the evolution of UK life insurance can be fully understood only by paying attention to tensions and conflicts in the epistemic field of actuarial science, attempts to influence the ‘rules of the game’ in the market field and the interrelations between the two.





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# Chapter 1

## Introduction

This dissertation is about the history of evaluation practices in life insurance from the early 1970s to the present, a period of large-scale change in global capitalism. The starting point for this dissertation is 1971, a year that is remarkable for several reasons. On August 15, 1971, the US president Richard Nixon suspended the convertibility of the US dollar to gold, signalling the end of the international monetary system with managed exchange rates that was designed at the Bretton Woods conference in 1944. The system's collapse gave rise to a turbulent period, which saw the gestation of a new world order – a world order in which financial capital would take an increasingly prominent role (Arrighi, 1994; Helleiner, 1994; Krippner, 2011). The system of floating exchange rates gave rise to unprecedented financial market volatility in the three decades since the 1970s, particularly so in the US and the UK (Bank for International Settlements, 2006; Stockhammer, 2012), which led Susan Strange (1997) famously to describe global finance as a ‘casino’. Since the 1990s, descriptions of contemporary capitalism have proliferated, though perhaps none as provocative. Other epithets include, for instance, ‘investor capitalism’ (Useem, 1996), and ‘financial capitalism’ (Carruthers, 2015). More recently, some have suggested that with increased concentrations of wealth we might be experiencing the onset of the ‘age of asset management’ (Haldane, 2014), or ‘asset management capitalism’ (Braun, 2016) – a term coined to describe the fact that asset managers have taken up an increasingly important position in the ‘investment chain’ (Arjaliès *et al.*, 2017), particularly after the global financial crisis.

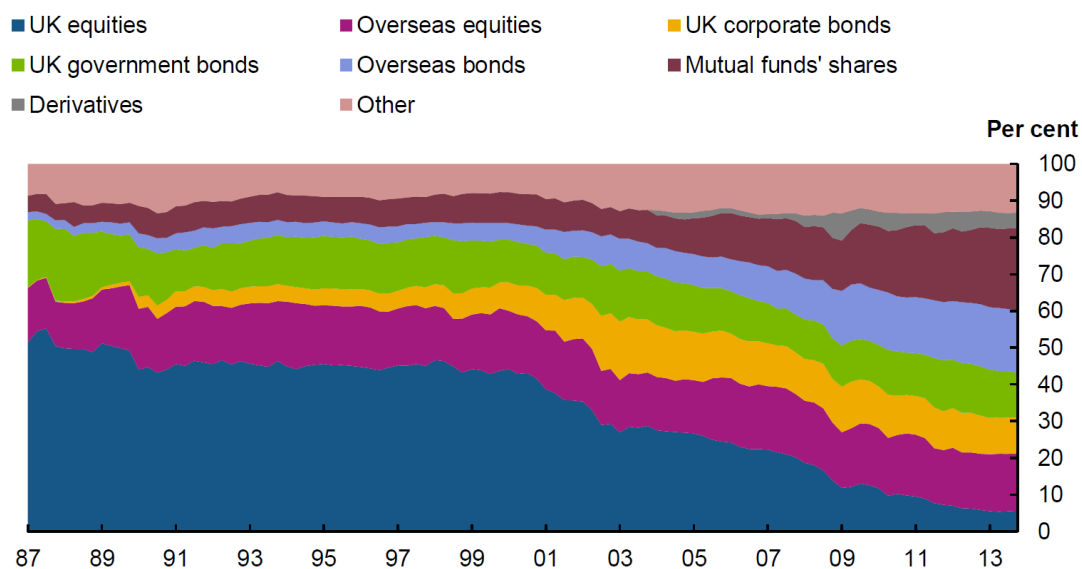
The now large literature on ongoing processes of ‘financialisation’ has extensively documented the ascendancy of financial capital (Epstein, 2005; Krippner, 2011; van der Zwan, 2014). Few (if any), however, have focused on how the nature of life insurance companies has changed in this period – even if life insurers are

amongst the most important investors in today's capital markets when considering the sheer volume of assets they have under management. What life insurance is and does has changed drastically since the 1970s. The world of life insurance as portrayed in Hollywood noirs like *Double Indemnity* and, even further back in history, in Charles Dickens's novels has faded. True, insurers still sell the traditional 'term assurance' policies that provided a murder motive in stories like *Double Indemnity*, and insurance fraud is still an important concern for insurers, but these are now relatively minor aspects of what insurers do.

Indeed, some argue that what life insurers do today is hardly recognizable as life insurance. A recent article in the *Financial Times*, for instance, claims that life insurers (and indeed insurers more generally) faced an 'identity crisis' (Ralph, 2018). In recent years, the article suggests, insurers have increasingly focused on providing services such as intermediating between customers and capital markets, rather than insuring risk. The most extreme example is Standard Life, an Edinburgh-based company founded as a life assurer in 1825. After its demutualisation in 2006, the company started selling predominantly 'fee-earning, capital-light investment products that have more in common with asset management' (Ralph, 2018). The company's change of strategy was underlined in 2017 when it merged with Aberdeen Asset Management and sold its life insurance business to the Phoenix Group. Although in other cases the shift has been less pronounced, the tendency is similar. Even those life insurers who still offer protection against insurance risks such as mortality, longevity and morbidity, earn their profits mostly from investment, not protection.

Changes in the structure of life insurance arrangements were accompanied by changes in insurers' asset allocations. In recent decades, life insurers have increasingly divested from stock markets and have channelled their funds into fixed-income investments (see figure 1.1), sometimes even via 'direct lending' to companies (Rule, 2018, 2019). This is a reversal of an earlier trend. Whilst for much of the nineteenth and early twentieth century, life insurers mainly invested their funds in government bonds and mortgages, since the early twentieth century insurers became increasingly invested in shares (Scott, 2002). Research by the Bank of

England has suggested that insurers' recent shift in capital allocation has important implications for capital markets, most notably: downward pressure on investment yields on government bonds, and increased financial market fragility (Haldane *et al.*, 2014). In the words of Andy Haldane: 'Equity does a much better job than debt of sharing risk between borrowers and lenders... [A] world without equity is likely to be one with poorer risk-sharing and weaker long-term investment' (Haldane, 2014, p. 11).



**Figure 1.1** Historical asset allocations of UK life insurance companies and pension funds (Haldane *et al.*, 2014).

In this dissertation, I examine how developments such as these are related to the ways in which life insurers evaluate the economic worth of insurance products and measure their risks. To see how, it is necessary to consider developments in British actuarial science. Within British actuarial circles, 1971 was also an important year, albeit less monumentally so. It was the year in which members of the British actuarial profession started debating the use of 'stochastic simulation' techniques to quantify financial risk.<sup>1</sup> In so doing, they broached a topic that would feature

<sup>1</sup> In contrast to the traditional actuarial 'deterministic' models, which seek to forecast the future through point-based estimates of key variables, stochastic models seek to forecast the future in probabilistic terms. Stochastic models, in other words, acknowledge that the future development of key variables is uncertain, and seek to capture this uncertainty in a range of possible outcomes rather than a single point-based estimate. In so doing, stochastic models allow for an expression in probabilistic terms of the degree of uncertainty and for the calculation of 'non-diversifiable' risk. This

prominently on the actuarial agenda in the decades to come and would lead to various controversies revolving around the question: how explicitly to measure and manage ‘financial risk’? Thus, while the demise of the Bretton Woods system set the stage for financial capitalism and ongoing processes of financialisation, financial risk emerged as an object of explicit actuarial calculation, which prefigured insurers’ lengthy struggle to deal with the uncertainty of expanding and increasingly volatile capital markets.

Indeed, the changes in insurers’ epistemic apparatus did not just come about smoothly. They were the outcome of a long process mired with tensions, frictions and often subterranean, but sometimes rather overt conflicts within the epistemic field of actuarial science. Controversies emerged, for instance, about the utility of stochastic calculus, the potential advantages of computer-based simulation, and the role that modern financial economics should play in actuarial practice. Debates such as these were not just ‘technical’ debates; they were also debates about how life insurance schemes should be run and what life insurance should be. In this dissertation, therefore, I investigate the interrelations between the different faces of the changing industry: between the changing evaluation practices on the one hand, and, on the other hand on the characteristics of contemporary life insurance arrangements and the changing forms of competition. Central in this endeavour is the two-pronged question: *how have evaluation practices in life insurance changed since the 1970s and how were these changes related to overall developments in the life insurance industry?*

## Studying Insurance, Studying Finance

Knowledge production is a crucial aspect of what life insurers do. For many of their products, the benefits of policyholders are contingent on future events, which presents an epistemological problem: how to know what these products are worth under conditions of uncertainty? An answer to this question, however convincing or otherwise it may be, is necessary for life insurers to go about their everyday business,

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by no means captures the extent of true uncertainty but rather generates a quantitative representation thereof.

to make underwriting decisions, to distribute surpluses across policyholders and shareholders, and to invest their assets. Evaluation practices – in short, the practices through which insurers estimate the economic worth of insurance products – are thus a piece of the institutional arrangement that structures the relations among policyholders, shareholders, company management, and capital markets.

There is a rich and voluminous body of historical and sociological literature on insurance. Studies of life insurance, and indeed insurance more generally, tend to focus on the practices through which life insurers make risk of the ‘diversifiable’ kind (van Hoyweghen, 2007). This is indeed what life insurance for most of its history has been about: reducing uncertainty by aggregating individual lives into risk pools (Ewald, 1991; Knights and Vurdubakis, 1993). In so doing, insurance turns uncertainty into ‘risk’. It makes risk calculable by relying on the logic of large numbers (Hacking, 1990). The larger the risk pool, the more reliable estimates of for instance average mortality may be, and the more the financial consequences of individual uncertainty may be reduced (Lehtonen and van Hoyweghen, 2014). Consequently, most of the sociological and historical literature on insurance has focused on the making of such risks and the epistemological problems it entails (Knights and Vurdubakis, 1993; Ericson, Doyle and Barry, 2003; van Hoyweghen, 2007; Alborn, 2009; McFall, 2011).

Most of the practices dealt with in this dissertation, however, concern non-diversifiable risk: a type of uncertainty the magnitude of which is proportional to the value of the object ‘at risk’. The financial consequences of uncertainty, in this case, cannot be reduced through diversification, because the risks are not independent but correlated. They depend on the same underlying process. Non-diversifiable risk has always been part of the insurance business, in lines of business such as flood insurance (Collier, 2008; Christophers, 2019), reinsurance (Jarzabkowski, Bednarek and Spee, 2015), and even in life insurance (McFall, 2011). In recent decades, however, insurers have increasingly sought to make such risks as financial market risk and ‘longevity trend risk’ calculable – a development that occurred at the same time as the rise of ‘financialised capitalism’. As scholars of financialisation have argued, financial actors (and logics) have taken up an increasingly dominant role in

contemporary capitalism, raking in an increasingly large share of corporate profits (Krippner, 2005; van der Zwan, 2014; Carruthers, 2015). At the same time, however, financial market fragility also has increased, leading for instance to unprecedented volatility in financial markets in the three closing decades of the twentieth century (Stockhammer, 2012; van der Zwan, 2014). To address these new risks, actuaries have increasingly borrowed from modern financial economics, particularly so from the early 2000s onwards, even when alternative approaches had been readily available since the 1980s. As a recent contribution to the literature has pointed out, in today's insurance markets insurers' evaluation practices tend to conflate traditional diversifiable insurance risks and non-diversifiable risks such as financial market risk (François and Frezal, 2018). This not only matters because it may give insurers a false sense of security about non-diversifiable risks (as François and Frezal suggest), but also because it influences what insurance is and does, ingraining for instance a financial logic into it. This study, therefore, examines the evolution of insurers' evaluation practices, with a specific focus on the introduction of techniques borrowed from financial economics.

In so doing, this study draws on and contributes to the social studies of finance. Although the 'social studies of finance' broadly refers to the application of concepts and methodologies from the broader social-sciences to the study of finance (de Goede, 2005a), it is often associated with a specific approach to research, which is inspired by science and technology studies and focuses on the concrete, material details of financial market practice. Central in these studies is the notion of 'performativity', or the notion that economic reality does not have an independent existence outside the practices that constitute it by making things calculable and tradable (Callon, 1998, 2007; MacKenzie, 2006; Muniesa, 2014). This study draws on this view because its main aim is to examine not whether insurers' evaluation practices accurately reflect economic reality, but rather what the consequences are of evaluating the economic worth of insurance products in specific ways. Although the focus on materiality, which is key to much of the work in the social studies of finance, and the performativity of economics is by no means new to the sociology of insurance (van Hoyweghen, 2007, 2014; McFall, 2009b; Ossandón, 2014; Meyers and van Hoyweghen, 2018), few have deployed such an approach to examine the



recent changes in the financial management of life insurance firms. This study thus contributes to the social studies of finance by examining the calculative agency of life insurers as key participants in financial markets.

## Exposition of Main Contributions

The expansion of subject matter for the social studies of finance is by no means the only intended contribution of this study. It also aims to contribute to recent attempts at integrating an analytical focus on the concrete details of financial market practice (as characteristic of the social studies of finance) with an understanding of the political economy of insurance and finance more broadly (Beunza and Ferraro, 2018; MacKenzie, 2018; Wansleben, 2018). In this context, I suggest, political economy may be understood as revolving around Harold Lasswell's (1936) famous question 'who gets, what, when and how?' Critics have argued that research in the social studies of finance has tended to neglect this question (Mirowski and Nik-Khah, 2007; Hardin and Rottinghaus, 2015), even if some of the key writings in this literature make a link between calculating capacities and distributional politics (e.g. Callon and Muniesa, 2005). This study seeks to reinforce this link by investigating how changes in the evaluation of insurance liabilities are related to the 'who gets what, when and how' of life insurance.

My strategy to achieve this objective is to pursue a budding line of investigation in the social studies of finance, which seeks to integrate a focus on material market practice with the notion of markets as fields (MacKenzie, 2018) – a notion that is prevalent in 'conventional' economic sociology (Bourdieu, 1997; Fligstein, 2001). Field theory provides a viable ontology of markets (and indeed of social domains more generally) alternative to the supply- and demand-schedule based view of economics (Fligstein, 2001; Beckert, 2009). It provides a relational view of economic agents as strategic actors that are positioned in a field, which is structured by institutions and networks that need actively reproduced. These structures shape competition among actors, who may abide by the rules or who may seek to influence the institutional structure of the field. Yet, field theorists typically rely on technological determinism, which perceives knowledge and technological

innovation as processes that provide strategic opportunities to actors in a given field from the outside. This determinism contradicts a central claim in the social studies of finance, which is the claim of ‘co-construction’ (a claim that has been imported from science and technology studies): knowledge and technology are not processes independent of society, influencing it from outside, but are intricately entangled with it (Jasanoff, 2004; MacKenzie, 2009). In line with the co-constructionist perspective, I propose to consider markets as fields that may be structured by various social forces including institutions, cognitive frames, networks, *and*, indeed, *evaluation practices*. In this view, explaining how a given market evolves requires an account of changes in adjacent epistemic fields (such as in this case actuarial science) and the interrelations between the two.

Applying this perspective to the case of life insurance allows me to make three further contributions. The first contribution is to think about the link between evaluation practices and issues of political economy. As this study shows, evaluation is not simply a technical affair; evaluation practices play an important role in structuring the relations among stakeholders in a given market field, particularly so when they become institutionalised. Particularly important in the political economy of life insurance, for instance, is the discounting regime – the set of rules that define how insurers should ‘discount’ future cash flows into a present value. This study shows, moreover, that evaluation practices may also shape the boundaries of fields: in recent years, for instance, there has been a large scale transfer of pension promises from defined benefit pension funds to insurance companies – a transfer that involved a change in the mechanism through which those promises are secured. This process may be referred to as the ‘privatisation’ of pensions –an underappreciated dimension of what some have referred to as the financialisation of pensions (Hassel, Naczyk and Wiß, 2019). This ongoing process of privatisation, I suggest, is possible only because the epistemic machinery in both fields have converged towards an ‘economic’ view of liabilities.

Secondly, this study contributes to our understanding of what sometimes has been referred to as the ‘individualisation of risk’ (Langley, 2004, 2006, 2008; Berry, 2016). In this narrative, the recent evolution of life insurance and pensions are

understood as the product of a neoliberal ‘governmentality’ that seeks to shift financial responsibility and risk to the level of the individual (Baker, 2000; Dean, 2010; O’Malley, 2012; Rose, 2017). (In pensions, this is manifested by the shift from defined benefit to defined contribution arrangements.) The field-theoretical perspective developed in this dissertation draws attention to quite another factor in bringing about this change: the strategic behaviour of participants in the market field (including, e.g., state actors and academic actuaries). I argue that seen from such a perspective the individualisation of risk in contemporary insurance arrangements may be understood as the product of incumbent insurers’ response to the challenge of a new type of insurance (unit-linked insurance). Rather than contradicting earlier contributions to the debate, this study adds to our understanding of how forms of neoliberal governmentality are cemented into concrete insurance arrangements.

This brings me to the third and final contribution that I wish to highlight here. This contribution relates to the ongoing debate about the hegemonic status of modern financial economics. A growing number of scholars link ongoing processes of ‘financialisation’ – broadly defined as the increasing influence of financial actors and logics on societies – to changes in the calculative practices of financial markets (Chiapello, 2014; Lengwiler, 2016; Besedovsky, 2018), and, indeed, to the diffusion of ‘financialised calculation conventions’ to domains of social life outside of finance (Chiapello, 2014; Chiapello and Walter, 2016). Although some scholars have started addressing the question of why some of modern finance theory’s models have become so influential in financial market practice (e.g. MacKenzie, 2006, 2007; Svetlova, 2012), it still very much remains an open question.

The present study cannot give a definitive answer to this question, but it nonetheless contributes to our understanding of the authority of modern financial economics by investigating its diffusion in the world of insurance (cf. Blyth, 2002; Abdelal, Blyth and Parsons, 2010). In so doing, I argue that the diffusion of modern financial economics was intricately entangled with a changing distribution of ‘epistemic authority’. Traditional actuarial evaluation practices require the formation of expectations about an inherently unknowable future (Beckert, 2016), an activity that traditionally belonged to the professional jurisdiction of actuaries. The core

models of modern financial economics (the so-called ‘no-arbitrage’ models of option pricing theory), however, circumvent the need to forecast the future by analysing the value of a contract ‘synchronically’ (Langenohl, 2018). As I argue in this dissertation, the influence of such no-arbitrage modelling on insurers’ evaluation practices took place at the same time as the legitimacy of actuarial judgment became increasingly disputed, particularly so after the failure of the Equitable Life Assurance Society in the early 2000s. The hegemonic status of these models in the context of life insurance is thus at least partially constituted by their ‘objectivity’ (the *formal* absence of ‘judgment’, even if the specification of the models requires judgment nonetheless) – a form of objectivity that, as I will show, needs to be actively constructed and maintained.

## Methodology

[I]nterrogating the past allows us to make taken-for-granted social institutions in the present unfamiliar and strange. In other words, a historical analysis allows us to see other possibilities contained within current social arrangements; we realize that the world does not have to be as it is, that the world is mutable and changeable. (Krippner in: Krippner, Lemoine and Ravelli, 2017, p. 4)

To explain the emergence of contemporary life insurance arrangements, this dissertation presents a historical sociology of life insurers’ evaluation practices. It is sociological because I seek to explain insurers’ evaluation practices as something that is shaped by specific social processes, not as a function of an internal logic. More specifically, as is good practice in the sociology of scientific knowledge, I adopt a ‘methodological relativism’, which is to say that ‘the same types of causes would explain, say true and false beliefs’ (Bloor, 1991, p. 5). The study is historical because I seek to identify those causes that shaped the evolution of insurers’ evaluation practices since the 1970s. Identifying the path-dependencies that characterise this evolution allows me to move beyond the taken-for-grantedness of the ways in which life insurers evaluate the economic worth of insurance liabilities today. In other words, by adopting a historical approach, I hope to achieve an effect similar to that described by Krippner in the quote above: to make today’s life insurance arrangements seem ‘unfamiliar and strange’.

The primary source material is a set of 44 semi-structured oral history interviews with people involved in the UK's insurance industry (see Appendix A), oftentimes directly so, in other cases more indirectly so, e.g., through their involvement in international organisations. These include interviews with company actuaries, regulators and supervisors, consultants and model providers, academic actuaries, actuaries working for investment banks, and people who currently have another position, such as non-executive director or who are currently in retirement. Many of my interviewees have taken up at least two or more of the above positions in their career.

Some of my interviewees have had long careers and they were involved in many of the events described in this dissertation. Others were at a relatively early stage in their career. The nature and length of the interviews varied accordingly. In some interviews, I asked my interviewees to walk me through their careers and to describe both routine practice and specific events that they considered pivotal in understanding the history of evaluation. These interviews tended to take up relatively more time, typically between 1.5 and 2 hours (the longest being 4.5 hours). In other cases, the interviews were more concise (typically between 45 minutes and 1.5 hours). These interviews tended to serve a direct purpose. Although I still asked interviewees about their individual careers, I steered the interviews more intently towards specific events and asked interviewees about particular practices. Follow-up interviews were used to clarify some of the rather more technical aspects of evaluation, leading in four cases to a repeat interview. To ensure that interviewees were comfortable speaking about sensitive issues, I promised them anonymity, unless they explicitly consented to otherwise.<sup>2</sup> Overall, this combination of interview styles allowed me to identify key events, situate them in a historical order and to grasp as adequately as possible the technical nature of the evaluation practices in which my interviewees have been involved.

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<sup>2</sup> A small number of interviewees preferred not to have quotes attributed to them; all but one of them were or are currently employed by government agencies. When quoted, they are referred to in an anonymised form, e.g. as 'interviewee CJ'.

I used three different methods to identify relevant interviewees. First, I scanned the main actuarial journals to identify individuals that have been involved in key debates within actuarial science. Second, and perhaps most importantly, I used the method of snowball sampling. This was useful to identify interviewees who are regarded by peers as key figures, but who have not necessarily been involved in actuarial debates, either because they work outside the actuarial profession (as in the case of some of the supervisors and regulators), or because they have simply been less involved with professional affairs. Third and finally, I also scanned company websites to identify potential interviewees that were not put forward by their peers. This was to ensure that also ‘fringe’ perspectives were included. The resulting interview sample contains just two women, which largely reflects the fact that the actuarial profession was male-dominated for most of the twentieth century (Dennett, 2004, p. 197). More women were contacted, but only two agreed to be interviewed. Overall, interviewees were selected to include leading voices in actuarial debates, people with specific expertise about certain topics, as well as a diversity of perspectives.

One of the major pitfalls of oral history interviews is that memory tends to be rather fickle, which raises the issue of the validity and reliability of oral history data (Ritchie, 2003). A particularly important problem is that interviewees’ accounts of past events may be self-serving. I tried to ascertain the validity and reliability of interview data by various means. First, most of the interview questions concerned routine practice, memory of which tends to be more reliable than memories about specific events (Thompson, 1988). Second, where I was interested in specific events, I tried to gauge the extent to which interviewees had retold memories about specific events on earlier occasions. Although this is likely to make memories more reliable, it is also likely to decrease their validity, because the purpose of those earlier retellings may have influenced the account in ways that may serve interviewees’ self-interest (Thomson, 2010). Third, and most importantly, I tried to corroborate key data points, firstly with the memories of other interviewees, and secondly with alternative sources including an extensive set of primary and secondary documentary material.

The set of primary documentary material, which supplemented the interview data, consists of documents from a variety of sources. A crucial set of documents includes articles published in the actuarial journals, the *Journal of the Institute of Actuaries* and the *Transactions of the Faculty of Actuaries*, which merged in 1993 to form the *British Actuarial Journal*. Conveniently, these journals publish transcriptions and summaries of professional debates alongside articles. This allowed me not only to trace the inception of new ideas but also to gauge their reception among peers. Other documents include regulatory communication (including, speeches, newsletters, briefings, consultation papers, ‘Dear CEO’ letters, etc.), articles in newspapers, magazines, and professional journals, occasional papers, consultancy reports, individual companies’ annual reports, and yearbooks of the actuarial profession (which include, e.g., actuarial exams). This material not only served to corroborate the interview data but also to fill the gaps left by it. The documentary material was particularly important in the analysis of the earlier decades of this history; less so for the later developments.

## Outline of the Dissertation

The dissertation proceeds as follows. In chapter 2, I review relevant bodies of literature in economic sociology and suggest a way in which insights from two different streams of research in economic sociology (the field-theoretical perspectives prevalent in conventional economic sociology and the performativity literature in STS-inflected economic sociology) may be fruitfully combined. In addition to these bodies of literature, the chapter also reviews key arguments in the sociology of scientific knowledge (which are used to clarify what is understood as ‘economic knowledge’), the sociology of insurance and, more briefly, the sociology of professions. The resulting framework guides the empirical analysis, which is presented in chapters 3-8.

Chapters 3 and 4 address the emergence of new forms of insurance and their reverberations in actuarial science and the life insurance market. Chapter 3 deals with the debates that emerged within the epistemic field of actuarial science in response to the introduction of unit-linked insurance, a new form of insurance that in contrast to

conventional insurance arrangements directly tied policyholder benefits to investment performance. In the 1970s, debates about the appropriate methods to calculate the cost and risk of insurance guarantees on unit-linked policies emerged – a development that was fostered by increased financial market volatility. By the end of the decade, actuaries increasingly agreed that new ‘stochastic methods’, such as simulation modelling, were appropriate to do so. The application of these methods, however, remained confined to unit-linked insurance. Chapter 4 deals with a series of changes in life insurance arrangements in response to the challenge posed by unit-linked insurance companies to insurers offering conventional with-profits arrangements. In the final decades, differences between unit-linked and with-profits insurance started to fade. While the structure of life insurance arrangements started to change, and competition among insurers increased, the actuarial approach to dealing with uncertainty did not change with it. When by the end of the century many insurers had gotten into significant financial trouble, and the worst affected among them, Equitable Life, was forced to stop writing new business, traditional actuarial methods came under increasingly large pressure.

Chapters 5 and 6 describe the emergence of a new market order; how the governance of UK life insurance changed in response to the crisis of the Equitable Life and the concomitant changes in insurers’ evaluation practices. Chapter 5 deals with the development of ‘market-consistent’ valuation – an approach to the valuation of insurance liabilities that draws on techniques borrowed from modern financial economics and the derivatives departments of investment banks (technical terms such as ‘market-consistent’ will be explained in the relevant chapters). Although there were already some actuaries within the profession who favoured this approach in the 1990s, it was only when actuarial expertise became heavily criticised and regulators imposed the use of new techniques that market-consistent valuation became prevalent. The chapter seeks to explain the ascendancy of no-arbitrage modelling as the dominant paradigm in the insurance field by investigating the strategic actions of actors in the epistemic field, and to describe the development of the market-consistent models for valuation purposes. Chapter 6 addresses another set of practices that emerged around the same time: risk-based capital modelling. In contrast to traditional actuarial practice, the new risk-based capital calculations



sought explicitly to quantify insurers' risks. The chapter describes the evolution of these models, how risk modelling may be understood as a social (collective) activity, and how its emergence affected the financial management of insurance firms. In so doing, the chapter shows that the combination of market-consistent valuation and risk-based capital calculation (both driven by regulatory change) changed the nature of the relation among groups of policyholders and shareholders.

Chapters 7 and 8 address the consolidation of this new market order. Chapter 7 deals with the institutionalisation of market-consistent valuation and risk-based capital calculation at the level of the European Union. This institutionalisation took place in the form of Solvency II, a European framework for the regulation of insurance capital, of which UK actors were main proponents. The chapter shows how the translation of market-consistent valuation and risk-based capital calculation into an explicit set of rules was partly a consequence of the way in which epistemic and supervisory authority was distributed at the EU level. The chapter further shows how attempts to translate the paradigmatic knowledge of market-consistent valuation into an explicit set of rules became overtly political. Finally, chapter 8 describes the emergence of the 'new life market' – a secondary market in which pension funds, insurance and reinsurance companies and other capital market participants buy and sell 'pension liabilities' and 'longevity risk'. The emergence of this market, I argue, was in part facilitated by changes in the epistemic machinery (as described in earlier chapters) underpinning the fields of insurance and pensions. Because market-consistent valuation puts a hypothetical 'market price' on pension liabilities and longevity risk, it makes it easier to conceive how they might be traded. This, in turn, changes the way in which pension promises are secured, from a relational mechanism to that of risk-based capital.



# Chapter 2

## Literature Review

The focus of this dissertation on the seemingly technical details of the ways in which life insurers evaluate the economic worth of insurance products is not just for the sake of it, but because those ‘details’ are both shaped by and shape much ‘larger’ issues concerning the societal role of life insurance in contemporary capitalism. The Janus-faced nature of this endeavour, faced simultaneously towards the ‘big picture’ of life insurance and the ‘details’ of life insurance practice, means I will have to engage with several bodies of literature. These include the social studies of finance, the sociology of insurance, the sociology of markets, the sociology of scientific knowledge, and, more briefly, the sociology of professions. In reviewing these fields, I do not just seek to summarise their key arguments, but will also seek to suggest ways in which contemporary debates in economic sociology may be carried forward. In particular, I seek to build on recent attempts at bridging the divide between the STS-inflected economic sociology prevalent in the social studies of finance and the more conventional perspectives in economic sociology that pay closer attention to the politics and political economy of financial markets (Beunza and Ferraro, 2018; MacKenzie, 2018; Wansleben, 2018). This chapter argues that it is possible to conceive of evaluation practices as a ‘social force’ that, alongside, for example, institutions, networks and cultural frames, structures the market for life insurance, by integrating a finitist perspective on economic knowledge with an understanding of markets as strategic action fields.

Making this argument requires three steps. First, I propose that a finitist perspective on economic theory – a perspective that is prevalent in science studies and that underpins much of the social studies of finance – provides us with an appropriate sociological understanding of what theory is and does. Second, I follow economic sociologists like Neil Fligstein to argue that a useful way of understanding the evolution of markets is to consider them as strategic action ‘fields’. Third, I

suggest that rather than perceiving ‘economic theory’ and ‘technology’ as external to the strategic action fields of life insurance (as field theory tends to do), we should consider the entanglements between the ‘epistemic field’ and the ‘market field’. In order to make these arguments, the chapter proceeds as follows. In the next section, I briefly review the role of evaluation in economic sociology, a field that acquired new impetus in the 1980s with the emergence of ‘new economic sociology’. I then move on to discuss literature in the ‘new, new economic sociology’, which has more explicitly paid attention to the role of knowledge practices in shaping economic relations, followed by a section in which I situate the dissertation in the sociology of insurance. Next, I briefly review the ‘finitist’ perspective of scientific knowledge, and indeed knowledge more generally, and consider how such a perspective might help to illuminate the evolution of actuarial evaluation practices. In the fifth section, I address a common critique on the social studies of finance (the critique that it tends to obscure politics) by arguing that a finitist understanding of economic knowledge provides additional tools for understanding the politics of evaluation, which, I suggest, does not need to detract from its ‘macro-politics’. In the final two sections before the conclusion, I review the ‘markets as fields’ perspective, describe some of the features of actuarial science as an epistemic field, and suggest some ways in which it is interlinked with the market field of life insurance more generally.

## Evaluation in Economic Sociology and the Sociology of Markets

Contemporary reconstructions of the history of economic sociology tend to carve up this history in three periods: a classical period, in which economic sociology featured prominently in the work of classical sociologists like Durkheim, Weber, Simmel and Marx; a stale period commencing in the 1930s; and, starting in the 1980s, a period of ‘new economic sociology’, which approached economic topics with renewed sociological vigour (Swedberg, 2003; Beckert and Janoski, 2006). For classic sociologists, economic sociology and the interrelations between the economy and society was an integral part of efforts to understand society as a whole. This also included a consideration of the techniques and practices of evaluation, albeit perhaps

somewhat limited. Most notable in this respect is the role that Weber ascribed to the emergence of double entry bookkeeping. For Weber (2001), double entry bookkeeping contributed to the rationalisation of economic behaviour, by focusing agents' attention on the 'bottom line' of economic transactions. What mattered, he argued, is that 'an actual adaptation of economic action to a comparison of money income with money expenses takes place, no matter how primitive the form' (Weber, 2001, p. xxxiii). The economic rationality of economic agents was a historical construct, not given by nature.

As sociology matured and the disciplinary boundaries between economics and sociology strengthened (Ingham, 1996; Velthuis, 1999), the tendency to historicize economic rationality faded. The jurisdictional separation between economics and sociology, sometimes referred to as 'Parsons's pact', implied an analytical separation between economic accounts of 'rational' action and sociological accounts of 'value-oriented' action (Stark, 2009; but see Beckert and Janoski, 2006). Proponents of new economic sociology sought to eclipse this division of labour, and argued that sociology should offer ways of understanding economic action, actors and markets, alternative to hegemonic economic theory.

It is no surprise, therefore, that the theoretical programme of new economic sociology was framed in opposition to neoclassical economics. Most influential was the embeddedness paradigm, notably articulated in Mark Granovetter's (1985) landmark article 'Economic Action and Social Structure: The Problem of Embeddedness'. Although there were already some important publications that retrospectively can be considered part of new economic sociology (Granovetter, 1973; Zelizer, 1979; White, 1981; Baker, 1984), many now see Granovetter's article as its starting point. Granovetter argued that the 'atomistic' view dominant in neoclassical economics failed to account for how actors' embeddedness in networks of durable social relations enabled and constrained particular courses of action. Economic sociology, according to Granovetter (1985), should offer an alternative to prevalent under- and over-socialised perspectives on economic action by focusing on how network relations shape economic action.

In subsequent years, the embeddedness paradigm generated large amounts of sociological inquiry, in which scholars identified a multitude of ways in which economic behaviour was socially embedded (Burt, 1992; Uzzi, 1997; White, 2002). There was little room for the problem of economic valuation, however; there was little questioning of the rationality of economic calculation itself. As critics have pointed out, the embeddedness paradigm leaves the core of the neoclassical model of the economic actor intact (Beckert, 1996; Krippner, 2001; Calnitsky, 2014). An economic sociology of this kind thus explains how economic action is structured by the networked relations in which it takes place but it does not provide an alternative model of how economic agency and its calculative capacities are constituted.

The embeddedness literature represents by no means the only line of research that came out of (new) economic sociology. In the United States, a variety of approaches emerged, which included, for instance, cultural economic sociology (Zelizer, 1979, 2013; Wherry, 2012) and different varieties of institutionalism (Fligstein, 1990, 1996; Nee, 2005). Similar to the embeddedness literature, institutionalists tend to focus on how implicit and explicit rules stabilise patterns of behaviour and constrain and enable particular courses of action, but less so on how the rationality of economic action is constituted. They focus, for instance, on the ‘context-bound rationality [which] serves as the foundation for examining the emergence, persistence, and transformation of institutional structures’ (Nee, 2005, p. 49). Cultural sociologists arguably go furthest in tackling the problem of economic evaluation by claiming that cultural factors may play an important role in sanctioning the legitimacy of markets (Zelizer, 1979, 1981), or by showing how the price of commodities may be imbued with singular social meanings (Zelizer, 1997; Velthuis, 2003). Their focus, however, remains on how economic action is oriented by social values, not on processes of calculation.

Another important line of research emerged in Europe, particularly via the sociology (and anthropology) of Pierre Bourdieu. Bourdieu (2005) explicitly recognises that the economic actor assumed in neoclassical economics – the *homo economicus* – is a historical product. The means (rational calculation) and ends (material gains) of economic action assumed in this neoclassical model are not innate

features of human beings, Bourdieu argues, but acquired competences. Key in his theorisation of economic action are the notions of habitus and field. While ‘habitus’ refers to actors’ ‘cultural equipment’ and embodied dispositions, ‘fields’ refer to the situations in which they are acquired and deployed (Bourdieu, 1997, 2005). Much like a gravitational field, a social field is constituted by the elements (or actors) that populate it, whose position in the field is in turn determined by their relation to other actors and their differential access to resources (or ‘capital’ in its different varieties); their position, in other words, constitutes their capacity to act, or power (Bourdieu, 1997; Fourcade, 2007). Field theory points to the strategies available to actors given the specifics of a given field: agents may act in accordance with the rules that define the structure of the field, contributing to their reproduction, or they may seek to alter them. For Bourdieu, then, economic action is a deeply cultural and relational phenomenon that requires historical and sociological explanation.

The notion of fields has found wider resonance in economic sociology, particularly so amongst the economic sociologists of the institutionalist variety (DiMaggio and Powell, 1983; Fligstein, 2001; Beckert, 2009; Fligstein and McAdam, 2012). Many now regard it as a potent alternative to the ontology of markets prevalent in neoclassical economics (Fligstein, 2001; e.g. Beckert, 2009). Although I agree with this, it should also be noted that the notion of fields as articulated in both Bourdieusian and institutionalist economic sociology tends to focus on how ‘the social world is present in its entirety in every “economic” action’ (Bourdieu, 2005, p. 3), but less so on the role of economic models and other material devices therein. In other words, it perceives technology as a process external to society (see below). To see how this tension may be alleviated, it is necessary first to review literature that explicitly deals with the problem of economic calculation. Towards the late 1990s, a new research programme emerged – dubbed the ‘*new, new economic sociology*’ (McFall, 2009a; McFall and Ossandón, 2014) – that sought to tackle this problem head-on.

## The 'New, New Economic Sociology' and the Performativity Thesis

The 'new, new economic sociology' – or STS-inflected sociology as it is sometimes called – finds its roots in Michel Callon's (1998) introduction to the *Laws of the Markets*, which, like Granovetter's article, has become a point of reference for economic sociology. In his introduction, Callon (who was one of the key figures of actor-network theory) argued that the central problem of economic sociology was to explain economic action under conditions of fundamental uncertainty – an argument that was shared by other sociologists (cf. Beckert, 1996). The solution proffered by the embeddedness thesis, Callon suggested, fell short of doing so successfully because it unduly asserted a separation between agency and structure, and, in so doing, was stuck again between over- and under-socialised models of agency.<sup>3</sup> According to Callon, an economic agent should not be understood as having an innate and rational calculative capability that needs to take account of an 'external' environment, but as an agent whose calculating capabilities at least partially depends on (or, perhaps better still, is constituted by) the environment.

The roots of the performativity thesis in actor-network theory are pertinent for understanding how Callon perceives the role of economics in the construction of the economy – 'economics' broadly conceived as all forms of knowledge involved in processes of 'economisation', not just 'academic knowledge' (Çalışkan and Callon, 2009). In a sense, Callon (1998) simply reinterpreted the 'network' of new economic sociology in actor-network theory terms. While network theorists tend to perceive the network as providing the individual agent with 'resources', actor-network theorists perceive agency as constituted by networks, or, what are sometimes referred to as 'material-semiotic networks' – networks comprised of both human and non-human entities (Latour, 2005; Law, 2008). Following this line of thinking, Callon (1998) argued that economic reality does not exist independently outside the knowledge and technology that contributes to its making. 'Calculativeness', he

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<sup>3</sup> Such a separation was not implied by Granovetter, according to Callon's reading, but came with later association between the embeddedness thesis and the Bourdieusian notion of social capital (see: Callon, 1998, pp. 11–12).



suggested, ‘couldn’t exist without calculating tools’ (Callon, 1998, p. 23), and that is precisely what economics supplies. Economics, in other words, does not just describe economic reality from an outside perspective but contributes to its making by formatting the ways in which economic agents calculate.

Like the embeddedness thesis in new economic sociology, the performativity thesis has generated a wealth of research on the role that economic knowledge and technology play in the ‘performance’ of the economy, especially so in the social studies of finance. Some scholars, for instance, focused on the role that technological devices such as telephones (Muniesa, 2007), computer screens (Knorr-Cetina and Bruegger, 2002), and the stock ticker (Preda, 2006) played in the enactment of financial markets. Others focused on the role of ‘economic knowledge’ in the form of, for instance, classifications and categorizations (Zuckerman, 1999; Poon, 2009; Wansleben, 2013), accounting techniques (Miller, 2008; Vollmer, Mennicken and Preda, 2009), and, indeed, financial economic theory (MacKenzie and Millo, 2003; MacKenzie, 2006; Svetlova, 2009, 2012, 2018a). What these studies share in common is their focus on the concrete materiality of financial markets in order to understand how the capacities of agents like traders (Beunza and Stark, 2004, 2012; Hardie and MacKenzie, 2007), supervisors (Williams, 2009; Coombs, 2016), or risk managers (Millo and MacKenzie, 2009) are constituted.

The performativity literature has by no means been the only approach within economic sociology that grapples with the calculative core of economic agency. Another, more recent approach takes ‘expectations’ as the central unit of analysis (Beckert, 2016; Beckert and Bronk, 2018). Under conditions of fundamental uncertainty, Beckert argues, actors establish expectations about the future that have a ‘fictional’ quality; that is, they are constructions of the future that combine ‘empirical facts’ with assertions that go beyond the realm of fact. Economic expectations are thus not futures waiting to be actualised, but ‘present futures’ that help to organise present action. Economic theory aids in the production of such present futures. But, Beckert warns, ‘the influence of theories is manifold and unpredictable’ (Beckert, 2016, p. 11). Hence, it is necessary to investigate how ‘credible’ narratives about the future are constructed and the role that calculation devices play therein (Beckert and

Bronk, 2018). As shown in this dissertation, however, not all devices need to be ‘credible’ to have the capacity to structure present action (cf. MacKenzie and Spears, 2014a), and not all evaluation practices equally engage with the future. Indeed, one of the practices central in this dissertation – market-consistent valuation – precisely seeks to circumvent the need to forecast the future by proposing a ‘synchronous’ analysis of the present (Langenohl, 2018). To examine insurers’ evaluation practices, this study thus adopts an approach more akin to the performativity perspective prevalent in the social studies of finance: one that is focused on the material manifestation of different forms of evaluation and understands ‘cognition’ as a distributed process.

## Knowledge Practices in the Sociology of Insurance

A focus on the materiality of knowledge practices is not entirely foreign to sociological and historical writings on insurance. Indeed, much of this literature has been concerned with the concrete practices of ‘making’ risks (van Hoyweghen, 2007). Insurance is often understood as a way of managing uncertainty by spreading the cost of adverse events in individual lives across a larger ‘risk pool’ (Ewald, 1991; Knights and Vurdubakis, 1993). Grouping together largely independent individual lives allows insurers to reduce overall uncertainty through the ‘law of large numbers’ (Hacking, 1990). This is the ‘insurance logic’: the transformation of individual uncertainty into risk by calculating the likelihood of a particular event using wider population data (van Hoyweghen, 2007; Lehtonen and van Hoyweghen, 2014). While it may be difficult for a single individual to predict how long s/he will live, predictions for population averages will likely be more accurate. Insurance risk, in other words, is diversifiable risk, in which benefits may be obtained from pooling together statistically independent lives.

As scholars in the sociology and history of insurance have extensively documented, insurers do not just ‘pool’ together individuals but also classify them (Knights and Vurdubakis, 1993; Ericson *et al.*, 2003; Bouk, 2016). Insurers differentiate different risk categories and seek to ‘price’ risk accordingly. The most obvious example variable used for differentiation in life insurance is age: few will

dispute that an individual, aged 80, buying a traditional ‘term assurance’ contract (in which the insurer pays a sum assured upon death) with a sum assured of £100 and a maturity of 10 years say, should pay a higher premium than a 20-year old individual buying the same contract. The core principle at work here is that of ‘actuarial fairness’ – the moral notion that, in contrast to some solidaristic conceptions of insurance, suggests that insurance premiums should reflect ‘individual risk’.

In practice, the ideal of actuarial fairness is not attainable due to various epistemic problems (Baker, 2000; McFall, 2019). For premiums to be ‘actuarially fair’, the characteristics of the population on which the premium calculations are based and the population that is actually insured needs to coincide – a condition that in practice is rarely satisfied (Heras Martínez, Teira and Pradier, 2016), and is complicated by ‘adverse selection’ and ‘moral hazard’ (Heimer, 1989; Baker, 1996, 2003). Much of the history of insurance has therefore been devoted to, on the one hand, the development of statistical techniques to make risk calculable, such as the development of life tables and pricing algorithms (Clark, 1999; Alborn, 2009; Turnbull, 2017); and, on the other hand, the development of risk selection mechanisms in underwriting practice (Porter, 2000; Ericson *et al.*, 2003; van Hoyweghen, 2007, 2014; Jauho, 2015) and other techniques for ‘devising’ markets in life insurance (McFall, 2015), including marketing (McFall and Dodsworth, 2009; Lehtonen and Liukko, 2010; Lehtonen, 2014). Most recently, sociologists have focused on insurers’ recent initiatives to design behaviour-based insurance schemes (Meyers and van Hoyweghen, 2018; McFall, 2019).

A core theme in the sociology of insurance literature is the governmental rationality or ‘governmentality’ underpinning insurance (Defert, 1991; Ewald, 1991; Knights and Vurdubakis, 1993; Dean, 2010). In this perspective, insurance operates as a technology of government, a ‘moral technology’ (Baker, 2000), which manufactures specific forms of solidarity, and may be used to pursue particular political aims. Solidarity, in this sense, refers not so much to a specific sentiment, but rather denotes a particular feature of concrete insurance arrangements, namely the ways in which individuals are bound together in an insurance arrangement that provides them with financial security. Insurance schemes can thus involve more or

less ‘solidaristic elements’ (McFall, 2019), either by design, such as in many healthcare schemes (Ossandón, 2014) or by necessity, due to the practical impossibility of charging ‘actuarially fair’ premiums (Meyers and van Hoyweghen, 2018; McFall, 2019). Viewing insurance in these terms thus allows one to trace how different political rationalities give expression to different types of insurance arrangement and forms of manufactured solidarity (Knights and Vurdubakis, 1993; McFall, 2007; Ossandón, 2014).

Paul Langley and others (Langley, 2004, 2006, 2008; Langley and Leaver, 2012; Berry, 2016) have adopted this analytical repertoire to investigate how pension arrangements in the UK (which have seen a shift from defined-benefit to defined-contribution arrangements) have become increasingly individualised, pushing financial responsibility and risk to the level of the individual. I argue that a similar development has taken place in contemporary insurance arrangements. However, while Langley relates the individualisation of risk to the prevalence of a neoliberal governmentality that aims to cast individuals as responsible investment subjects, this dissertation focuses on the role of evaluation practices as strategic resources in a competitive dynamic that led to changes in contemporary insurance arrangements from ‘within’ – a view that will be further elaborated below.

The main emphasis of this dissertation is on those evaluation practices that involve techniques developed outside actuarial science, most notably in financial economics. While historically insurance has primarily revolved around the calculation of ‘diversifiable risk’, the techniques that are central in this dissertation seek to quantify forms of ‘non-diversifiable risk’ (François and Frezal, 2018). In contrast to diversifiable risk, non-diversifiable risk refers to a situation in which there is a strong correlation between the events that are grouped together. For example, when investing the premiums of two separate policyholders in the stock market, the chances are likely that the value of one investment will drop if the value of the other investment also drops (and vice versa). Investing policyholder premiums in capital markets always involves some degree of non-diversifiable risk. Since the 1970s, insurers have increasingly sought to make forms non-diversifiable risk calculable in an attempt to rationalise its management. I argue that the emergence of epistemic

machinery to quantify non-diversifiable risk – in particular through techniques borrowed from modern financial economics – has had important implications for the ways in which insurance, as a mechanism to distribute risk across populations, operates. To see how, I will draw on some of the core arguments from the sociology of scientific knowledge

## Paradigms, Finitism and the Sociology of Scientific Knowledge

The performativity literature provides useful conceptual resources for investigating the influence of ‘economics’ on the operations of financial and insurance markets. Often absent from debates about performativity, however, is a consideration of what is meant by ‘economics’. Two common issues, in particular, have led to conceptual slippage: 1) a conflation between economics and academic economic theory; and 2) a lack of regard given to the nature of economic theory, which in some cases leads to a rather rigid understanding of economic theory and provides limited scope for understanding processes of epistemic change. In addressing these issues, I discuss some concepts that will facilitate the analysis of the evolution of insurers’ evaluation practices.

The first, and more straightforward of these issues arguably finds its origin in the ambiguity of the French term for ‘economics’, *économie*, which at the same time also means the ‘economy’ (Muniesa, 2016). As a corollary, ‘economics’ might be taken to refer to academic economics, or, more broadly, to any activity and thing that participates in the making of ‘the economy’. Scholars in the social studies of finance tend to adopt the latter definition (Callon, 2007), precisely because a narrow focus on ‘academic economics’ quickly leads to a ‘linear model’ of innovation in which theory is first produced within academia and then ‘applied’ outside it (MacKenzie, 2017) – a model that I wish to avoid.

This leads to the second issue with common interpretations of the performativity literature: a lack of regard of the nature of economic theory. Many interpretations of performativity resort to a common sense conception of economic

theory, as having an ‘intrinsic’ meaning, which comes with normative prescriptions that can either be followed or ignored. This view is not only at odds with the (sometimes implicit) conception of economic knowledge that underpins some of the key works on performativity (MacKenzie, 2006, 2009), but also coincides poorly with empirical accounts of economic theory in action (Svetlova, 2009; e.g. Beunza and Stark, 2012). As the anthropologist Horacio Ortiz (2014) for instance showed, key concepts of modern finance theory may in practice have a variety of different meanings, each of which may become dominant as the situation changes.

A fruitful way of understanding what economic knowledge is made of can be found in MacKenzie’s (2006) study on the performativity of option pricing theory. In this study, MacKenzie argues that the Black-Scholes-Merton model for pricing a specific type of financial option provided an ‘exemplary problem solution’ that indicated how similar problems could be addressed. The model, in other words, became ‘paradigmatic’, and the development of option pricing theory proceeded through analogical extension from one case to the next. In order to have an influence on the world, moreover, the problem solutions of option pricing theory needed to be ‘translated’ – to borrow a term from actor-network theory (Callon, 1986; see also: Sundberg, 2007) – into concrete practices that may involve the use of technical devices that format the calculating capabilities of their users. In the case of option pricing theory, for instance, the Black-Scholes equation entered the trading floor of the Chicago Board Options Exchange in the form of paper sheets that allowed traders quickly to compare options prices. This translation involved not just the application of theory to practice (as in the linear model of innovation), but the analogical extension of an exemplary problem solution that involves the mutual construction of ‘economics’ and the problem at hand. The paper sheets, for instance, incorporated an extra parameter (future dividends), which had been abstracted away in Black, Scholes and Merton’s initial problem solution (MacKenzie, 2006, pp. 160–161).

MacKenzie’s conception of theory as at core a set of exemplary problem solutions is rooted in a ‘finitist’ understanding of scientific knowledge – an understanding that is prevalent in the ‘sociology of scientific knowledge’ (Barnes, Bloor and Henry, 1995), but also finds applications in broader social theory (Barnes,

1995). Simply put, finitism suggests that the meaning of concepts and rules is not intrinsic but is generated by their concrete application to specific cases. This may have some counterintuitive implications. Rooted in Wittgenstein's (1958) philosophy of language, finitism proposes, for instance, that any behaviour can in principle be interpreted as to be in accordance with a rule. In reality, of course, this is not the case; there are social forces that prevent us from interpreting a rule in any way we see fit. As David Bloor puts it:

According to meaning finitism, we create meaning as we move from case to case. We could take our concepts or rules anywhere, in any direction, and count anything as a new member of an old class, or of the same kind as some existing finite set of past cases. We are not prevented by 'logic' or by 'meanings' from doing this... The real sources of constraint preventing our going anywhere and everywhere, as we move from case to case, are the local circumstances impinging upon us: our instincts, our biological nature, our sense experience, our interactions with other people, our immediate purposes, our training, our anticipation of and response to sanctions, and so on through the gamut of causes, starting with the psychological and ending with the sociological. (Bloor, 1997, pp. 19–20)

If meaning is not intrinsic to language but determined by language usage, this poses potential problems for attempts to elucidate the meaning of specific terms through language. If we are pressed far enough to explain the meaning of a word, we may end up having to refer to concrete examples, not just other words. Explaining the meaning of a term by other words may lead us into an 'infinite regress' in which the problem of meaning may be repeated *ad infinitum* (Wittgenstein, 1958; Bloor, 1997). This infinite regress, finitism suggests, can only be put to a halt by social processes, not intrinsic meanings (Bloor, 1997, 2007).

Extending this notion to the case of economics, we might say that the meaning of an economic theory or accounting classification is not determined by specific interpretations of the theory or the rules that constitute the classification, but is created in the concrete application of those theories and rules (Hatherly, Leung and MacKenzie, 2008; MacKenzie, 2008). A sociological account of evaluation practices would thus seek to identify the 'social causes' that shape the application of concepts

and rules in specific cases, particularly those causes that may explain the variation of specific concepts and rules across time and space.

Although it is perhaps easiest to see how finitism may apply to a sociological investigation of rule following – which is indeed what most empirical investigations have done (e.g. MacKenzie, 2008; Pardo-Guerra, 2011; Milyaeva, 2014) – finitism provides the foundations for a general theory of knowledge, not just rules-based knowledge. It also applies to knowledge conveyed by paradigms. Rules and paradigms are often recognised as different things; indeed, many argue that paradigms cannot be reduced to a set of rules (e.g. Barnes, 1982; Daston, 2016).<sup>4</sup> Whilst a rule encodes behaviour by appealing to ‘commonly known’ terms, a paradigm provides an exemplary problem solution that indicates how a problem may be addressed and through which the theory may be understood. There are, however, also some important similarities. Although, as Barnes, Bloor and Henry (1995, p. x) argue with respect to scientific knowledge, it is indeed ‘difficult to specify what a theory is as an historically situated entity, and it is quite impossible to identify it as a set of statements’, it is nonetheless possible ‘to think of a scientific theory as an evolving institution’. That is to say, as the list of appropriate applications of a specific theory evolves, so does the meaning of that theory.

In order to see how insurers’ evaluation practices may change, it is useful to consider the role of paradigms in post-Kuhnian accounts of scientific change. Crucial in such accounts is the way in which scientific theory is ‘learned’. Indeed, scientific theory can only be learned by working through a set of exemplars, through which a prospective scientist ‘learns the accepted similarity relations (Barnes, 1982, p. 52). In normal science, scientists actively construct the meaning of concepts by extending exemplary problem solutions (paradigms) to new cases and classifying observed phenomena as instances of one concept or another. They may focus, in particular, on ‘epistemic objects’ – objects that are characterised by ‘a lack in completeness of being’ (Knorr Cetina, 2001, p. 190), a lack that researchers may seek to fill. In the

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<sup>4</sup> Following finitism, it may be argued that there is no fundamental difference between rules and paradigms; the differences between them thus have to be traced to social causes that prevent us from reducing paradigms to a set of concrete rules.



finitist account of normal science, then, the underdetermined nature of concepts and theory turns scientific activity into a fundamentally creative activity, no matter how much it may appear like mere ‘puzzle-solving’.

In Kuhn’s (1970) account of scientific change, periods of ‘normal science’ are interchanged with periods of ‘revolutionary science’. As Barnes (1982) and others have pointed out, however, the notion of revolutionary science is what turned Kuhn’s account of scientific change into a ‘functionalist’ one. In this account, the anomalies that accumulate in periods of normal science will ultimately lead to a functional necessity for revolutionary change. I agree with Barnes that such an account provides little analytical merit, for it provides no basis for understanding what constitutes ‘necessity’ and what it is that changes in a revolution (e.g., is it the general world view of scientists, or is it the ascendance of a new dominant exemplary problem solution?). The notion of revolutionary science can, therefore, ‘at best be no more than an empirical description of some selected episodes in the history of science’ (Barnes, 1982, p. 57) – a description that needs to be explained by factors other than intrinsic necessity. This is indeed part of what this dissertation seeks to achieve: to explain sociologically why a key paradigm in modern financial economics became a central paradigm in actuarial science too.

In sum, acknowledging the underdetermined nature of knowledge thus allows not only for an investigation of the social factors that shape the emergence of particular calculative rationalities but also for an understanding of how those calculative rationalities may change over time. In other words, a finitist understanding of knowledge thus provides a useful starting point for examining the evolution of evaluation practices in insurance by focusing our attention on the social causes that shape how exemplary problem solutions are extended from one application to the next. Similarly, it provides a means for understanding the social and political dynamics that may emerge as ‘paradigmatic’ forms of knowledge are translated into an explicit set of rules – a topic that will be further examined below. First, however, I examine the implications of a finitist account of economic knowledge for how we could think about the politics of evaluation.

## The Macro- and Micro-Politics of Evaluation

The performativity literature has not been without its critics. An important line of critique has been that research in the social studies of finance tends to pay insufficient attention to the institutional politics of finance. By focusing on how economic theory formats calculative agency, some of the critics argue, research in the social studies of finance tends to reinforce the hegemonic status of modern finance theory. Hardin and Rottinghaus (2015) assert for instance that the field ‘cedes too much to the dominant discourses of financial economics. It assumes that financial models are idealized visions of what markets should be’ (pp. 549-550). In focusing on the minutia of market practice, the social studies of finance thus lose sight of, or ‘obscure’ the broader institutional and political dynamics that shape the adoption of some forms of economic theory and not others (Mirowski and Nik-Khah, 2007).

In my reading of the performativity literature, however, it opens up an aspect of politics that is less frequently discussed in political economy. By focusing on how paradigms are extended to concrete problems, it becomes possible to attend to what is sometimes called the ‘micro-politics’ of finance (Power, 2007; Beunza and Ferraro, 2018). It allows for an investigation of the role that e.g. ‘interests’ play in the analogical extension of exemplars to concrete problems. Such research may aid our understanding, moreover, of how the ‘performative power’ (Svetlova, 2012) of a given body of theory is constituted. In some cases, the concrete usage of theory may be rather non-committal and thus have little apparent agency (Ortiz, 2014). In others, however, the agency of theoretical constructs may seem rather more ‘durable’, for instance, because a given practice is entrenched in the materiality and organizational structures of market practice (MacKenzie, 2006, 2009; MacKenzie and Spears, 2014a). The performative power of a specific exemplary problem solution may thus increase as it is translated into – and becomes part of – the ‘knowledge machinery’ (Knorr Cetina, 2007) underpinning market practice, regardless of how credible the representations of value and risk thus produced are perceived to be.

Focusing on the micro-politics of ‘translations’ thus provides us with additional means of understanding the politics of evaluation. One of the pitfalls in such an endeavour is to focus primarily on those cases in which the use of economic theory contributes to a convergence between the postulates of a model and the world it purports to describe (Bamford and MacKenzie, 2018). To understand the politics of evaluation, however, it may be equally important to focus on cases of ‘counterperformativity’ in which the use of a model leads to the undermining of its key postulates (MacKenzie, 2006; Bamford and MacKenzie, 2018). This undermining may be the outcome of a variety of social processes. For instance, the use of a model may invoke behaviour that conflicts with patterns of action assumed in the model. Similarly, counterperformativity may be the outcome of ‘gaming’: the optimisation of returns given ‘risk’ (as calculated through risk models) and a set of regulatory constraints (cf. Funk and Hirschman, 2014; Stellinga and Mügge, 2017; Stellinga, 2018); or, indeed, the deliberate use of a model in order to avoid certain outcomes predicted by a model (Bamford and MacKenzie, 2018). Model usage and agents’ observations of other agents’ model usage (Esposito, 2013) are thus an important dimension of understanding the micro-politics of evaluation.

When it comes to the relation between economic theory and economic practice, it is thus possible to discern two ‘levels’ at which epistemic politics may take place. One is at a level that corresponds to the type of institutional politics on which institutionalist accounts may focus: a type of politics that focuses on the ascendancy of ‘ideas’ (Blyth, 2002; King, 2005; Mügge, 2011), or ‘policy paradigms’ (Hall, 1993; Henriksen, 2013) as hegemonic reference points for the definition and resolution of policy problems. The other is at the micro-political level, where actors may seek to influence how a specific paradigm is translated into concrete practices of calculation. A finitist understanding of economic theory thus leaves space for more politics, not less. In addition to understanding how social forces like ‘interests’ may shape the uptake of particular forms of paradigmatic knowledge, it also enables us to understand how the meaning of theory itself is shaped by those social forces.

## Markets as Fields, Evaluation Practices as Institutions

The fact that a finitist understanding of knowledge provides space for both the macro- and the micro-politics of evaluation does not mean that research in the social studies of finance so far has paid sufficient attention to the macro-politics of finance. It is the aim of this section, therefore, to integrate a perspective on evaluation practices with sociological accounts of ‘market order’, and particularly with the notion of markets as ‘fields’. Although it is often assumed that there are some irrevocable tensions between the two approaches, some scholars have recently argued that insights from both approaches may nonetheless fruitfully be combined (Fourcade, 2007; MacKenzie, 2019). In making this connection between evaluation practices and broader field relations, I exploit an analogy that was hinted at earlier in this chapter – an analogy between scientific theories and institutions (Barnes *et al.*, 1995).

Field theory provides a meso-level account of how social order may emerge and evolve in a given domain of social life, such as markets (Bourdieu, 1997; Fligstein and McAdam, 2012). It presents a relational view of actors whose position in a field defines their interests vis-a-vis other actors – a position that needs actively reproduced – and focuses on the role of state agencies in shaping the institutional arrangements that enable and constrain their behaviour. The central analytical divide is that between ‘incumbents’ – actors whose interests tend to be reflected in the institutional structure of the field – and ‘challengers’, who may seek to influence the rules of the game (Bourdieu, 1997; Fligstein, 2001; Fligstein and McAdam, 2012, p. 13). The crucial analytical advantage of the notion of fields is its ability to account for the relation between social structures and agency. For instance, challengers are not just passive agents that stick to the rules set by incumbents; they may seize on events ‘external’ to the field (a technological innovation, or a political event for example) as opportunities for undermining the existing rules of the game. If successful, an alternative structure may emerge, which redefines who is on which side of the divide between incumbents and challengers (Fligstein, 1996, 2001; Fligstein and McAdam, 2012).

A crucial factor in explaining the dynamics of stability and change in Fligstein and McAdam's rendition of field theory (which is most directly applicable here) is the notion of adjacent fields. Many of the resources on which incumbents may rely for the reproduction of the institutional structure of a field may derive from their relations to actors in adjacent fields. Most obvious here is the role of the state, which may itself be conceived of as a set of strategic action fields (Fligstein and McAdam, 2012). The relations to incumbent actors in state fields often provide a crucial resource for incumbent groups in market fields to reproduce their dominant position. Under normal conditions, this relation will typically be based on a congruence of interests between the incumbent groups in state and market fields. In some pivotal moments, however, state actors may perceive it in their best interest to link up with the challengers in a market field and to help them to undermine existing institutional structures therein. This may for instance be the case when there are changes internal to the adjacent state fields, such as shifts in the relations between the different actors groups and their positions within the field. Adjacent fields such as states thus often play a crucial role in the production, reproduction and the dynamics of stability and change in the evolution of market fields by incumbents and challengers with resources for strategic action within the field of interest (Fligstein and McAdam, 2012).

Another important aspect of fields in stabilising interactions between incumbent and challenger groups is the existence of 'internal governance units', the organisations or actors that ensure compliance with the rules of the game. Although as Fligstein and McAdam (2012, p. 95) argue the main role of internal governance units is thus to stabilize the 'original settlement' of the field, internal governance units may 'serve many other specific purposes' too, including for instance the dissemination of information, the representation of field actors in state fields, the certification of professionals or the mediation of conflicts between field actors. In many fields, internal governance units thus play an important role in structuring the positions of different groups of actors and are therefore important sites for struggle between incumbents and challengers. Even if their existence is often justified by reference to the general interest of the field, incumbents often (though not always) retain a strong degree of control over internal governance units.

One of the key elements of Fligstein and McAdam's rendition of field theory is that in many cases the 'internal' dynamics of a field are driven by 'external' events. Such external events may invoke episodes of 'contention', which – 'at least for a period of time – can often feed on itself' (Fligstein and McAdam, 2012, p. 22). External events, in other words, spark a dynamic in which a number of 'social forces' (cf. Martin, 2003) – such as networks, institutions, 'local cultures', and 'cognitive frames' (Fligstein, 2001; Beckert, 2009) – interact with one another in a prolonged period of struggle between different groups of actors that seek to shape the structure of the field in their favour. Although Fligstein and McAdam (2012, p. 85) acknowledge that it may be 'hard to separate the more incremental shifts and positioning contests ... "internal" to the field from what is going on outside', they nevertheless maintain that it is important to sustain this distinction.

Field theory's distinction between 'external events' and 'internal dynamics' has important implications for its treatment of the role of technology, expert knowledge and techniques of quantification in the structuring of the relations that are constitutive of market fields. Maintaining such a separation leads to a tendency in field theoretical accounts to preclude an understanding of how techno-scientific innovation often takes place at least partly *within* specific fields of practice. It is therefore at risk of endorsing a linear model of innovation in which theory exclusively develops within the narrow confines of academic practice after which it is then simply applied outside of it. At the root of this problem is the deterministic understanding of technological change that underpins most of field theory (see for instance: Fligstein, 2001, p. 4). This is problematic for an investigation of the interrelations between the evolution of evaluation practices and the markets in which they are deployed, and makes field theory seem at odds with the performativity literature. One of the theoretical novelties of this dissertation is to free field theory from its 'determinism' and to consider the evolution of evaluation practices as endogenous to fields. After all, 'all field struggles are also, always, performativity struggles' (Fourcade, 2007, p. 1027). Evaluation practices structure the social relations in a given field, and, as such, incumbents and challengers may strategically seek to influence evaluation rules, norms, and standards in their favour.

To see how evaluation may be regarded as an endogenous social force in a market field, it is useful to consider economic theory as a kind of institution, as does the finitist perspective reviewed above. In this view, the meaning of ‘theory’ is determined by the set of problem solutions that are considered ‘legitimate’, that are central in the epistemic field, and that serve as the standard against which other applications are measured. Not all participants in a given field may perceive the dominant set of problem solutions as ‘legitimate’. In the epistemic field – which similarly to Whitley’s (1984) notion of the ‘intellectual field’ denotes a ‘general social unit of knowledge production and coordination’ that includes but also goes beyond the university-based disciplines<sup>5</sup> – ‘challengers’ may seek to reorganise epistemic practice around a new set of exemplary problem solutions, replacing or providing an alternative to the currently dominant exemplars. The process of change that may emerge from this, however, cannot be understood entirely as an ‘internal’ phenomenon, especially not in the case of British actuarial science – a hybrid field that is populated mostly by practitioners and just a few academics. This relatively hybrid character of actuarial science brings to the fore the importance of the institutionalisation of particular evaluation practices (Millo and MacKenzie, 2009; Henriksen, 2013; MacKenzie and Spears, 2014a; François and Frezal, 2018). The institutionalisation of evaluation practices may be the result either of their routine use by market practitioners or because they are prescribed by market regulations. Change in the epistemic and market fields is thus intricately entangled: on the one hand, the development of new calculative tools may provide actors in the market field with an opportunity to further entrench their interests or, in the case of challengers, may be deployed in an attempt to undermine the social relations in a field; on the other hand, the institutionalisation of particular evaluation practices in the market field may affect the structure of the epistemic field.

Another (strikingly parallel) weakness of field theory and indeed economic sociology more generally is its formalistic conception of law and its role in structuring field relations. As Edelman and Stryker (2005, p. 529) point out,

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<sup>5</sup> In this thesis, I deploy the notion of ‘epistemic field’ rather than ‘intellectual field’ (Bourdieu, 1968; Whitley, 1984) to avoid conflating the rather pragmatic field of actuarial science with the broader intellectual space dominated by public intellectuals.

conventional economic sociology tends to treat law ‘as an exogenous, determinative, and coercive force’ that opens up and closes down particular courses of action that strategic actors may pursue. This formalistic reading of law, however, precludes the ‘endogeneity’ of law, or the idea that ‘the content and meaning of law is determined within the social field that it is designed to regulate’ (Edelman, Uggen and Erlanger, 1999, p. 407). In this view, law is understood ‘more as a rhetorical and symbolic resource than as an articulate mandate’, the meaning of which is constructed dynamically by the actors involved in its enactment (Edelman *et al.*, 1999, p. 407). What it means to comply with regulation, in other words, is not just determined by the words of the law but also by the interaction between regulators and supervisors, and the regulated (Thiemann and Lepoutre, 2017; Thiemann, 2018). For the field theoretical account developed in this thesis, this implies that we should not just take into account how incumbent market actors relate to those state actors involved in writing rules and regulations, but also their relation to those actors (or ‘internal governance units’) involved in determining their appropriate application.<sup>6</sup>

In sum, then, if we discard the technological determinism that underpins many field-theoretical accounts and if we leave aside its somewhat formalistic conception of law, a field-theoretical approach provides a useful resource for examining the interrelations between the evolution of markets and evaluation practices. The key features of this approach are: 1) an analytical distinction between challengers and incumbents; 2) a focus on the role of state agencies as part of the fabric of market fields, and, more generally, an appreciation of the role of ‘adjacent fields’ in the evolution of a market field; 3) a sociological understanding of technology, ‘scientific knowledge’ and law, which perceives them as processes that are at least partially internal to the field; and 4) a focus on the entanglements between the epistemic field and the market field.

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<sup>6</sup> Note that supervisors are a special kind of ‘internal governance unit’: they are state actors and therefore do not just reflect the interests of incumbents but mediate between state and market interests. As Singer (2007) notes with respect to capital regulation, supervisors are typically caught between two aims: they seek to balance international competitiveness of the domestic industry with the aim of protecting domestic customers from economic catastrophe (see also: Mügge, 2006; Thiemann, 2014; Thiemann and Lepoutre, 2017).



## The Actuarial Profession and Its Role in the Governance of Life Insurance

Although I argued that there are important benefits to the analogy between actuarial science and science ‘proper’, there are also important differences between these fields. Many of the articles published in actuarial journals, for instance, are written by company actuaries, not academics, and although there are some actuarial science departments at UK universities (notably at Heriot-Watt University in Edinburgh and at City, University of London), professional organisations are crucial agents in the epistemic field. The purpose of this section is to examine the social organisation of actuarial knowledge production.

Knowledge production is at the core of what life insurers do, and it is therefore no surprise that the history of the industry is intimately tied up with the history of actuarial science (Alborn, 1994, 2009; Bolnick, 1999; Clark, 1999). Life insurers typically sell long-term promises, the value of which may be contingent on numerous factors like future stock market returns, mortality, morbidity and operating expenses. To ascribe a ‘present value’ to such promises, various judgments need to be made. The genesis of life insurance in its ‘modern’ form finds its roots in the development of techniques like life tables and compound interest rate formula. Although life insurance was a thriving business already sometime before such techniques were developed (Clark, 1999; McFall, 2011), the development of these techniques significantly altered the way in which insurance companies were run and the structure of the products that they sold (Alborn, 2009). Key moments included, for instance, the publication of Edmond Halley’s mortality tables in 1693, the consecutive developments in techniques for constructing life tables and the development of early pricing formulas (Turnbull, 2017, chapters 1 and 2).

As actuarial techniques developed, so did the profession. Crucial in this development was the Society for Equitable Assurances on Lives and Survivorship (more commonly known as the Equitable Life Assurance Society), which was the first company to introduce the ‘whole-of-life’ policy – a policy that in contrast to earlier life insurance contracts (providing protection for a pre-defined term only) paid

a ‘sum assured’ with certainty, regardless of when the policyholder would die. Such ‘whole-of-life’ policies thus ‘transformed life assurance into a form of long-term savings vehicle’ (Turnbull, 2017, p. 50). The Equitable, moreover, charged flat premiums that, in accordance with ‘scientific principles, were based on the age of the policyholder at the inception of the contract (Ogborn, 1962; Dennett, 2004; Alborn, 2009). It was also the first company to refer to its chief executive, Edward Rowe Mores, as an actuary (Ogborn, 1956). In the first half of the 19th century, actuaries were increasingly recognised as a specific professional group, and the skills needed for insurance liability valuation and premium calculation became increasingly associated with them. The professionalization of actuaries was further facilitated by the founding of the London-based Institute of Actuaries in 1848 and the Edinburgh-based Faculty of Actuaries in 1856 (Ogborn, 1956; Dennett, 2004).

Jurisdictional struggles are crucial for any process of professional institutionalisation (Abbott, 1988); for the actuarial profession, things were no different. Central in the profession’s struggle was, on the one hand, an attempt to claim special expertise by relying on the scientific allure of probability theory, and, on the other hand, the need to differentiate actuarial expertise from that of statisticians (Alborn, 1994). While the development of mathematical statistics and actuarial science had been distinct throughout most of the 18<sup>th</sup> century, by the early 19<sup>th</sup> century they started to converge. While actuarial science borrowed concepts and techniques from mathematical statistics, mathematicians perceived actuarial science as an appropriate field to demonstrate the usefulness of core ideas (Alborn, 1994) such as mathematical expectations, the central limit theorem and Bayesian inference. By the mid-19<sup>th</sup> century, however, competition amongst life insurers had surged, which led both companies and policyholders increasingly to ignore actuarial advice. Within this context, actuaries struggled to position their expertise between scientific objectivity (as expressed for instance in the notion of ‘natural laws of mortality’) and professional judgment (which was needed to mark off a role for actuaries in the management of insurance business). By the end of the century, the actuary was a figure whose expertise was legitimised by having knowledge of mathematics and an ability to form judgments about the appropriate application of such knowledge (Alborn, 1994; Porter, 1995).

The success of the actuarial profession has thus been dependent on its ability to obtain ‘epistemic authority’, which (following Barnes’s [1986, 1988] conception of authority as ‘power minus discretion’) may be defined as a delegated capacity to perform routine epistemic operations like company valuations.<sup>7</sup> A pivotal moment for the actuarial profession was the 1870 Life Assurance Companies Act, which created a statutory role for actuaries in the management of life insurance business (Daykin, 1992). The Act required insurers’ to perform an actuarial investigation of their financial position every five years, or, for companies established prior to the act, every ten. In so doing, the 1870 Act established a ‘freedom with publicity’ regime, in which the valuation actuary was free to decide on the appropriate valuation methods, provided that the methods and assumptions were publicised. Supervision of insurers by public authorities remained marginal (Daykin, 1992; Turnbull, 2017). With the 1870 Act, actuaries thus acquired a prominent role in the governance of life insurance, which was reflected by the distribution of authority: actuaries were responsible for deciding on the appropriate valuation methods (epistemic authority) as well as for scrutinising the companies’ financial position (supervisory authority).

The actuarial profession thus played a key role in the governance of life insurance. With the 1870 Act, the epistemic field of actuarial science was ‘nested’ into the market field of life insurance. Concomitantly, professional journals have served not just for sharing ideas amongst actuaries, but also for establishing norms about appropriate actuarial methods. Hence, these journals publish transcripts of the debates at the Institute or Faculty’s sessional meetings, where authors present papers before publishing them. Most of the research, moreover, is facilitated by professional organizations, which set up working parties that bring together actuaries from different companies (and later academic actuaries) to perform research on specific issues. In the freedom with publicity regime, in other words, responsibility for the

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<sup>7</sup> Barnes’s definition of authority as ‘power minus discretion’ fits somewhat awkwardly with the notion of ‘actuarial discretion’ that practitioners use to describe the freedom actuaries have to decide on the appropriate methods to do, e.g., statutory valuations. The difference, however, is that Barnes’s notion of power implies formally unrestrained discretion, whilst the ‘discretionary space’ of actuaries is formally defined by statutory requirements. Actuarial discretion, in other words, implies a rather more limited scope of ‘discretion’ than that implied in Barnes’s definition of power.

governance of life insurance was delegated by public authority to the actuarial profession, which sought to legitimate its private authority by forming a strategic alliance with statisticians and by appealing to a set of epistemic standards and norms such as actuarial prudence, rational argument and ‘freedom with publicity’ (see chapter 3).

Although the actuarial profession was the key actor in the governance of life insurance companies for much of the twentieth century, this situation started to change by the end of the century, when the capacities of public agencies started to expand. Initially, this expansion consisted primarily of an increase in the number of actuaries employed by the Government Actuary’s Department, which was the main supervisory agent in the 1980s and 1990s. By the end of the 1990s, however, the UK followed an international trend towards the integration of banking and insurance supervision, manifested by the establishment of the Financial Services Authority, which opened up the governance of life insurance to professional groups outside the actuarial profession. At the same time, moreover, competition from the accounting profession intensified due to a wave of demutualisations and mergers (see chapter 4), which in combination with the shift towards statutory regulation (see chapter 5), contributed to the erosion of the boundaries between the adjacent fields of life insurance and banking.

When the boundaries between adjacent fields are porous and when actors can move more easily between different ‘professional ecologies’ (Abbott, 2005), scholars in the sociology of professions have argued, the importance of professional identity may weaken (Seabrooke and Tsingou, 2009). Under these conditions, it becomes increasingly important to focus not just on the role of particular professional identities in the governance of a field but to focus on actors’ coalition-forming strategies (or ‘hinges’) that lead to the formation of alliances or coalitions spanning across different ecologies and fields (Abbott, 2005; Seabrooke and Tsingou, 2009). The ability of actors to form alliances across different professional ecologies strengthens their capacity to make claims on specific policy ‘locations’. Because the erosion of boundaries between adjacent fields will provide actors within those fields with new opportunities to form alliances and to promote specific practices, actors

may actively pursue ‘hinge’ strategies that contribute to the (partial) erosion of boundaries between fields.

Putting actors’ coalition forming strategies across fields and ecologies at the centre of our analysis of the evolution of evaluation practices brings to the fore the competitive dynamics not just between different professional groups (Abbott, 1988), but also between what MacKenzie and Spears (2014b) refer to as ‘evaluation cultures’ – groups that cross-cut organisations and have

... an at least partially shared set of practices, preferences, forms of linguistic or non-linguistic communication, meanings and beliefs, which perhaps includes an ontology or a distinctive set of assumptions about what ‘the economic world’ is made of, together with a mechanism of socialization into those practices and beliefs. (MacKenzie and Spears, 2014b, p. 395)

A focus on the formation of coalitions between actors who operate in different but linked ecologies that are moreover located in multiple adjacent fields, provides a model for understanding the actuarial profession’s internal struggles and its dynamics of change. It provides, in other words, an additional tool for understanding why certain evaluation practices may become dominant by focusing on the strategies of what field theorists call ‘institutional entrepreneurs’ (Fligstein, 1996). Actors, for instance, may put forward a new set of evaluation practices (which may be construed, e.g., by borrowing elements from ‘evaluation cultures’ dominant in competing professions and neighbouring fields) as the most effective means to solidify the profession’s jurisdictional claims. Different evaluation cultures may occupy the same epistemic field, with proponents of each strategically seeking to elevate theirs as the dominant tradition (i.e. to the position of incumbents) by forming alliances across different fields and ecologies. This perspective, I argue, helps explain why the no-arbitrage models of modern finance theory became dominant exemplars in the epistemic field of actuarial science.

In sum, then, to perceive actuarial science as an epistemic field ‘nested’ in the market field of life insurance allows for an investigation of the interlinkages between changes in the dominant evaluation cultures and the ways in which evaluation practices structure the market field. The incumbent-challenger structure characteristic

of field theory is applicable in both types of field, but plays out in slightly different ways: in the market field, actors struggle for control over competition, while in the epistemic field actors struggle for dominance in epistemic production, and may seek to bring about changes in the institutionalisation of evaluation practices in the market field in order to do so. As suggested by the sociology of professions, actors' ability to form coalitions among different professional ecologies – coalitions that may straddle across market and epistemic fields – is a crucial factor in shaping the evolution of fields.

## Conclusion

To conclude this chapter, the theoretical novelty of this dissertation may be summarised thusly: this dissertation integrates a focus on both the concrete technical dimension of evaluation with a focus on the politics of markets by drawing on the notion of markets as fields and conceptualising evaluation practices as a social force that participates in the structuring of such fields. This perspective allows for the analysis of the dynamics within the epistemic field, the market field and the interlinkages between them. Central in the conceptualisation of cultural change in the epistemic field is the Kuhnian notion of paradigms, which (following the finitist tradition) refers simply to the exemplary problem solutions that are central in an evaluation culture. The epistemic field is then construed as a social force in the market field, where it interacts with other social forces such as institutions, networks and cultural frames.







## Chapter 3

### Financial Risk as Epistemic Object

In 1971, the Staple Inn Society hosted a rather unusual sessional meeting of the Institute of Actuaries. The meeting revolved around a paper presented by the actuary Sidney Benjamin, an active and well respected member of the profession who worked as a consultant at the newly established insurance practice of the actuarial consulting firm Bacon & Woodrow. Unusually (it was a long established convention to publish the papers presented at the sessional meetings alongside the debates in the professional journals), Benjamin's paper was never published in the Institute's journal – the *Journal of the Institute of Actuaries (JIA)* – and neither was the discussion that followed its presentation. Ronald Skerman, the Institute's president, had turned the public meeting into a private one. Skerman judged that the contents of the paper and discussion were too sensitive for it to be discussed publicly. In his paper, Benjamin proposed to use a novel approach to estimate the value of a relatively new type of product – a unit-linked insurance contract with maturity guarantees (explained below). Seemingly to his own surprise, Benjamin's model indicated that such policies were far more expensive and a lot riskier than was typically assumed, something that few present at the meeting were prepared to accept. One participant later described it as the 'stormiest I have ever attended' (Smith in Corby, 1977, p. 274).

The sessional meeting was the starting point of a decade long controversy about the nature of financial risk and the possibility of modelling the stock market. In many ways, the meeting was a symptom of the ongoing substantive changes experienced by the UK's life insurance industry. Unit-linked insurance – a particular blend of investment and insurance products – first appeared in the late 1950s as an alternative model of insurance that, according to its proponents, would eliminate some of the 'social conflicts' that were built into conventional life insurance arrangements. How available surpluses were distributed across policyholders was to

be determined by the market, not the actuary. Rather than reducing the role of the actuary, however, the combination of investment and insurance shifted the focus of the actuary towards financial risk as an epistemic object to be investigated by people like Benjamin. Moreover, the approach that Benjamin suggested – computer-based stochastic simulation – meant a significant departure from traditional actuarial practice. In this chapter, I analyse the controversy that was initiated by the meeting and explain how it was shaped by the diverging interests of those involved and how it was resolved; but before doing so, I will provide some background on the emergence of unit-linked insurance.

## The Emergence of Unit-Linked Insurance: ‘Nothing to Lose But the Chains of Actuarial Thinking’

On February 9<sup>th</sup>, 1973, another remarkable meeting took place, this time at the Institute of Actuaries Students Society. The insurance entrepreneur Mark Weinberg addressed a crowd of actuaries as follows:

I see unit-linked assurance not as a vehicle for making the Actuary obsolete, but rather as an opportunity to use his unique qualities – through an opportunity for him to employ himself in weighing up complicated mathematical relationships, rather than to use his time attempting to resolve conflicts of interest of his own making or exercising social judgments which he is no more qualified to assess than a layman. (Weinberg, 1973, p. 20)

In his opening remarks, Weinberg admitted jokingly that he was ‘not sure whether I am brave to be here or whether you are brave to invite me here’ (Weinberg, 1973, p. 1). Weinberg was the founder of Abbey Life, the first UK insurer solely devoted to unit-linked insurance, and, at the time he gave this speech, was a director of the second unit-linked company he founded, Hambro Life. Both companies sold policies that were significantly different from the ones traditionally sold by UK life insurers. Their ‘accountant-designed’ policies, although ‘mathematically less elegant’, nonetheless eliminated ‘virtually all the conflicts and rigidities of traditional actuarial forms’, Weinberg claimed. For Weinberg, who was invited to the Institute’s Students’ Society to talk about the role of actuaries in insurance, the challenge posed by unit-linked insurance would have important

implications for actuaries: while in conventional insurance arrangements actuaries performed crucial management roles, Weinberg argued that the core competence of actuaries was mathematics, not management. His talk at the Institute's Students Society anticipated major changes in the industry, in terms of policy design as well as the role of actuaries in managing life insurance.

Up to the 1960s, life insurers typically sold a mixture of 'non-profit' and 'with-profits' policies. Such conventional insurance had its roots in the late eighteenth century, when, as noted in chapter 2, the Equitable Life Assurance Society introduced 'scientific insurance'. In contrast to pre-scientific insurance (which was typically short-term – e.g. one year – and based on 'flat premium' rates that were the same for all policyholders regardless of age and gender), the premium rates of 'scientific insurance' were determined by the 'net present value' of expected policyholder claims that sometimes could take place decades into the future (Turnbull, 2017). Based on predictions of mortality (given e.g. age and gender) actuaries would then prudently estimate the economic value of the policy and the size of the premiums needed to pay for it. The long-term nature of such contracts and (the overly) prudent estimations of mortality and interest rates meant that the first 'modern' insurers quickly accumulated large surpluses. To release this surplus, they adopted a with-profit system in which with-profit policyholders would 'participate' in the profits (and losses) of the company. How surplus should be distributed, however, was an open question, a question that, according to Weinberg, would lead to a 'long dispute' out of which 'the actuarial profession was born' (Weinberg, 1973, p. 9).

Thus, quite apart from pricing and product design, actuarial techniques played a role in distributing surpluses across policyholders in an 'equitable' manner. This was (and still is) no easy task, because in so doing, according to Weinberg, 'conflicts of interest' emerged among different generations of policyholders, between policyholders and shareholders, between life offices and policyholders, and between agents and policyholders. 'One of the considerable achievements of the actuarial profession over the years', he argued, 'has been to find ways of coping with and living with these various conflicts of interest' (Weinberg, 1973, p. 10). Crucial, in

this respect, was the ‘reversionary bonus system’. To distribute any surpluses, insurers would periodically announce an increase in the sum assured of the underlying contract, expressed as a percentage increase per premium paid. The bonus announcements, which were based on rather laborious calculations and took place at best every five years, became ‘a potent marketing device’, creating a tension ‘between the prudent social practice of well-regulated investment and the choreographed drama of public spectacle’ (Alborn, 2002, p. 69).

Reversionary bonus practices came under significant pressure in the 1930s and 40s. Inflation and interest rates fluctuated wildly in the first half of the twentieth century and the market value of insurers’ investments was rather volatile. As a consequence, estimations of surplus could diverge significantly from year to year. Insurers, moreover, became increasingly invested in equities, which further exacerbated the problem of estimating the size of companies’ surpluses. It posed the question of how surplus emerging in the form of capital gains (as opposed to dividends) should be accounted for. Lacking a clear answer to this question, various companies rapidly accumulated large undistributed surpluses. Thus, on the one hand, there was a perceived need to increase reversionary bonuses bringing actual benefits more in line with policyholders’ actual share of surplus. On the other hand, the precariousness of surplus estimations required a system flexible enough such that, in a period of declining market values, companies would not be stuck with irreversible reversionary bonuses that had been promised in better times.

To counter these problems, life insurers revised their reversionary bonus system to include, also, a bonus the size of which was to be determined at maturity – a ‘terminal bonus’. Terminal bonuses provided companies with increased ‘elbow room’ to see ‘that each policyholder obtained a fair return as he went out’ (Blunt in Benz, 1960, p. 11). Actuaries had long recognised the need to use ‘something more stable than market values’ in the valuation of assets and tended to use such ‘elbow room’ to ‘smooth’ policyholder benefits (Turnbull, 2017). In this view, an ‘equitable’ surplus mechanism was one that would dampen market fluctuations such that fortunate generations of policyholders would contribute to enhancing the benefits of less fortunate ones. While this was commonly understood as a good, the methods

through which the degree of such smoothing was to be decided were less clear. How, after all, should actuaries know whether capital markets were in a good or a bad state? Indeed, those less sanguine about terminal bonuses pointed out that ‘there had been virtually no explanation, either by companies to their policyholders or within the profession as to how those bonuses were determined’ (Barton in Melville, 1970, p. 347).

The tensions in conventional insurance were further exacerbated by the increased post-war emphasis on life insurance as a ‘savings and investment vehicle’. Indeed, as Langley points out, investment apparatuses have increasingly displaced the calculative machinery and performances of ‘insurance and thrift’ (Langley, 2008).<sup>8</sup> But whereas Langley sees neoliberal government reforms as a catalyst of this shift, it appears that many of the necessary substantive transformations in UK life insurance already took place in the 1960s and 70s. Since then, insurance companies have increasingly diversified into selling ‘investment’ and pension products (Lehtonen and Liukko, 2010). Conventional insurance, a 1969 *Economist* article comparing different forms of insurance suggested, has an important weakness when used primarily for saving and investment:

The conventional policyholder gets no assurance that all the profits earned on his share of the fund will go to him, after a fair allowance for the cost of covering the risk that he might die early. True, he shares in the profits earned on the without-profits policies. True, the benefits from income on reserves built up in the past. But he is not told how much of these combined profits have been stacked away for the future, instead of being allocated to him. (Anon., 1969, p. 14)

The shift in emphasis from protection to saving and investment entailed a changing conception of ‘equitable’ surplus distribution, which reflected poorly on the role of the actuary as the final arbiter in surplus distribution mechanisms. Thus, quite apart from mitigating the epistemic problem of surplus distribution, unit-linked insurance

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<sup>8</sup> While Langley (2008) emphasises that post war insurance became increasingly focused on investment and less so on protection, it is important not to downplay the savings and investment function of early life insurance. Indeed, as Alborn argues, life insurers were amongst the ‘first fund managers’, whose investment practices formed an important aspect of attracting new business.

was presented as more ‘equitable’ and ‘fair’ mechanism for saving, while benefitting from the advantages of investment.

The first insurers to sell unit-linked insurance contracts collaborated with unit trust companies – companies that were becoming increasingly dominant in the adjacent field of investment management. Unit trusts are the UK equivalent of American ‘mutual funds’, which first emerged in the 1920s, but would take off after the Great Depression. In contrast to investment trusts, unit trusts were seen as ‘transparent’ investment pooling mechanisms, particularly in the US, that allowed small-time savers to dip into capital markets. Investors could purchase ‘units’, each comprising a basket of investments; hence ‘unit trust’. The first unit trust in the UK was Municipal & General, founded in 1931 and later became a subsidiary of Prudential. While unit trusts enjoyed great success in the US, they remained a fringe phenomenon in the UK well into the late 1950s (Morecroft, 2017, chapter 7). In 1959, total assets under management by UK unit trusts amounted to £100 million, not much of an increase compared to the £84 million twenty years earlier in 1939 (Morecroft, 2017, p. 250); in 1960, however, this figure increased to £191 million, and, in 1965 increased further to £500 million (Grant and Kingsnorth, 1966, p. 17).

The increase in unit trust investments happened around the same time as the appearance of unit-linked insurance. The first unit-linked policies appear to have been offered in 1957, when Unicorn Trust offered 500,000 units that were eighty percent invested in ‘well-spread ordinary shares’ with the London and Edinburgh insurance office ‘offering an endowment policy based on the price of Unicorn units’ (Anon., 1957, p. 437). Not much later, in 1958, Northern Assurance started offering an in-house unit-linked scheme, albeit only to existing customers as a top-up to their existing pension plans (Anon., 1958). Over time, due to both marketing and tax advantages – e.g. UK unit trusts were not allowed to market their policies door to door (Melville, 1970, p. 312) – the contracts were typically sold by life offices, some incumbent, others, like Weinberg’s Abbey Life and Hambro Life, newly established.

Designs of unit-linked policies diverged significantly, not only in terms of their underlying investments (linked to a portfolio of equities, property, bonds, or a mix of those) but also in terms of the guarantees that they provided to policyholders.

The divergence, as described in an early actuarial paper on the topic, was characterised by ‘degrees of unorthodoxy’ (Bailey, 1962). Some actuaries opined that unit-linked contracts should closely resemble ‘orthodox’ policies and provide, for instance, protection against fluctuations in the market value of units by guaranteeing a sum assured of at least a fixed percentage of total premiums paid. Others, like Weinberg, argued that such ‘orthodox’ unit-linked policies contained ‘most of the conflicts of interest and rigidities which had ... been built into the traditional life assurance industry’ (Weinberg, 1973, p. 17). Galfrid Melville, who set up the insurance branch of the unit trust group Save and Prosper, similarly emphasised that unit-linked policyholders preferred unit-linked policies because it avoided such conflicts:

In effect, intending unit-linked policyholders are saying to the life office involved 'We don't want your guarantees on investment. We don't want either you or your actuary to have to be bothered about the future of interest rates, nor about future capital appreciation (or depreciation), nor about short-term fluctuations in the market, in making your decisions about premium rates or surplus distribution. We just want you to credit the “savings elements” of the premiums we pay to your unit fund (or funds), invest these to the best of your ability, tell us exactly what you are doing and why, and give us exactly our share of whatever happens, good or bad, as determined in the market place. We want you to concentrate your thoughts on investment management rather than on its subsequent distribution.’ (Melville, 1970, p. 313)

The unit-linked approach as envisioned by people like Melville and Weinberg thus ‘rejected’ the ‘reversionary bonus method of distributing surplus’ and it rejected ‘the traditional role of the actuary as the all-important and mysterious custodian of such surplus, distributing it in amount and in form according to his judgment alone’. The unit-linked approach, in other words, would take ‘the market place to be the sole arbiter as to when and how interest and capital surplus should be distributed’ (Melville, 1970, p. 313). While some of the incumbent insurers started selling unit-linked policies akin to conventional insurance, the management of several unit trust companies, which were typically run by accountants, set up their own life insurance companies. The accountants, according to Weinberg, tended ‘to be pretty hard-headed, straightforward chaps, with a solid knowledge of arithmetic but no algebra’,

and, he added, in designing their policies, their ‘reasoning’ was ‘simplistic and mathematically unsophisticated’ (Weinberg, 1973, p. 18).

Nevertheless, even the challenger firms did not completely adhere to Melville’s ideas. For example, Melville’s own office, Save and Prosper, had written unit-linked business containing ‘maturity guarantees’ (i.e. promises to pay at least a nominal amount roughly equal to the total sum of premiums at maturity). In his speech, Weinberg noted that ‘if you must introduce guarantees into unit-linked policies, you should make sure that they are guarantees which are so remote that it is almost inconceivable that you will ever be called upon to pay out under them’ (Weinberg, 1973, p. 17).

At the time of Weinberg’s speech (February 1973), the guarantees offered by challenger firms indeed seemed remote. In the two years that followed, however, stock markets slumped, which made maturity guarantees seem much more likely to ‘bite’. As a consequence, the emergence of unit-linked insurance did not limit actuarial enquiries to issues of mortality and expenses, as suggested by people like Weinberg and Melville, but rather expanded its scope to include financial risk embedded in maturity guarantees, a topic first explicitly discussed in Sidney Benjamin’s 1971 paper.

## Benjamin’s Probabilistic Approach to Reserving

Benjamin’s paper departed significantly from traditional actuarial studies. Up to then, actuaries had not made any significant attempts at quantifying financial risk. In the nineteenth century, insurers invested primarily in fixed-income assets (Scott, 2002), the major risk being ‘roll-over’ risk – the risk that they would not be able to invest incoming premiums at interest rates sufficiently high to match the interest rate assumed in the ‘premium basis’ (the set of assumptions used to determine premiums).<sup>9</sup> To protect themselves from this risk, actuaries treated it in the same way

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<sup>9</sup> Actuaries used a different valuation basis for different purposes. The basis used to determine premiums for non-profit business, for instance, was typically more ‘prudent’ than the one used for with-profits business.



as mortality risk, with actuarial prudence. In deciding on a valuation basis, they would pick ‘cautious’ assumptions for both interest rates (used to discount future cash flows to a ‘present value’) and mortality rates. When using a ‘best estimate’ for the likelihood of certain cash flows arising, one expects that in half the cases the premium income would suffice to cover the outgoing claims. When using a ‘prudent basis’, however, the perceived likelihood of income exceeding outgo increases, leading in most cases to the emergence of additional surplus that could then be distributed across with-profits policyholders.

As noted above, the way in which insurers invested their assets changed significantly in the first half of the twentieth century, primarily because they started investing increasingly in equities (Dodds, 1979; Scott, 2002; a topic that is further discussed in chapter 4). Equity investments introduced a mismatch between insurers’ assets and liabilities. The timing and size of cash flows arising from equity investments (dividends and the capital proceeds of selling a share) are uncertain. This was not necessarily considered to be a problem for the solvency of conventional insurers (although, as noted above, it *was* considered problematic for the distribution of surpluses) if they invested only a relatively small share of their assets in equities. At least initially, it was also considered not to be a problem for unit-linked insurance, the underlying assets of which were sometimes fully invested in equities. The risk that claims would arise at a point when stock markets were in a dip was almost entirely owned by the policyholder, whose benefits were tightly linked with the investment performance of the underlying trust. The maturity guarantees on these policies were considered sufficiently remote.

In his paper, Benjamin suggested otherwise. He argued that a different approach to valuation was needed to assess the degree of caution in the valuation basis, noting that the typical actuarial approach of choosing an interest rate for valuation ‘on a cautious basis’ had its weaknesses when applied to guarantees. In the actuarial approach, the valuation basis would be strong if the likelihood that real interest rates would fall below the chosen discount rate was considered small and vice versa. However, he continued,

It is not so clear what is meant by a strong or weak basis of valuation in a situation where the benefit is sharply dependant (sic) upon a fluctuating situation, but a corresponding approach can be built by using the concept of a ‘probability of ruin’ which is familiar from text-book examples of probability games and which is a central idea in ‘risk theory’ as developed especially by continental actuaries. (Benjamin, 1971, p. 5)

Risk theory is a mathematical approach to evaluation problems that first emerged in Scandinavia.<sup>10</sup> While in the nineteenth and twentieth century, British actuarial science had become relatively isolated from statistical theory, ties between insurance and academic mathematicians in Scandinavian countries were quite strong, particularly in the early twentieth century. At this time it was, for instance, ‘quite common for prominent university professors to work part-time as actuaries for life insurance companies’ (Martin-Löf, 2014, p. 8). Two of the most well-known mathematicians, Filip Lundberg and Harald Cramér, developed a modelling approach to evaluate surplus in general insurance business that pivoted on the calculation of a company’s ‘probability of ruin’ – defined as the probability of a company’s reserves dipping below zero at any given point over the timespan of the contract. Crucially, they sought to do so by modelling the surplus of the company, subject to premium income and claims outgo, as a continuous random process. Benjamin sought to apply a similar approach to the modelling of equity-linked guarantees. As Benjamin noted, however, ‘the problem of long-term business has not received much attention [in risk theory]’ (Benjamin, 1971, p. 5).

Using risk theory as an exemplary problem solution, Benjamin wanted to know what levels of reserve were needed to render the probability of the company ending up with a shortfall (i.e. the ‘probability of ruin’) less than 1/50. To do so, he sought to produce a model of the ‘fluctuating situation’ of the stock market that could be used to project forward future stock market returns. Rather than defining a model in statistical terms, however, Benjamin argued that, for his purposes, future stock market returns could be adequately modelled as a continuation of past annual

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<sup>10</sup> Apart from some ‘internalist’ histories, little is known about the sociological conditions in which risk theory emerged. Considering its later influence on insurance practice, this is a topic that merits further investigation.

returns recurring in random order. Using the De Zoete stock market index, he produced 50 simulations each projecting stock market returns forward over a period of 20 years, by randomly picking annualised return experiences from a pool of 51 historic periods derived from stock market data over the period 1919-1970. Out of 50 different simulation paths, he then picked the one that produced the worst result (corresponding to the 2% ‘probability of ruin’ threshold), arguing that firms’ reserves needed to be large enough to cover such a shortfall. For a ten-year unit-linked policy with a simple maturity guarantee, Benjamin concluded, ‘a suitable reserve [for the guarantee] ... would be equal to approximately 25 percent of the present value of all future basic premiums in force’ (Benjamin, 1971, p. 29), a significant reserve that to most actuaries seemed rather excessive.

As noted at the start of this chapter, Benjamin’s 1971 was never published. In 1976, however, Benjamin would present an updated version of the paper at the International Actuarial Congress in Tokyo, which suggested an even stronger ‘starting reserve’ of 30 percent. Benjamin acknowledged that the model’s results seemed ‘unexpectedly high’. Nevertheless, for Benjamin the results indicated that the combination of unit-linked insurance and maturity guarantees was ‘probably not a commercial proposition’ (Benjamin, 1976; Turnbull, 2017).<sup>11</sup> Many remained sceptical and sometimes even hostile to Benjamin’s approach; his paper, however, did raise significant doubt about the adequacy of actuarial prudence in the management of unit-linked insurance and succeeded in putting financial risk on the actuarial agenda.

## ‘A Drunken Stagger Around a Random Walk’

In the early 1970s, the Institute of Actuaries set up two consecutive working parties on maturity guarantees both led by Brian Corby, an actuary at the influential company Prudential. The goal of the first working party was to scrutinise Benjamin’s

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<sup>11</sup> In economic terms, maintaining such large reserves is considered to carry an ‘opportunity cost’. The firm’s owners could have used that capital differently, perhaps getting a better return on capital than when total capital investments for unit-linked business are considered. The amount of capital needed to finance particular lines of business is thus an important aspect of considering the commercial viability of such activities.

assumption that annual stock market returns were independent. The second working party was set up to recommend appropriate reserving practices. Neither of these working parties came to an agreement on these issues and their reports were never published. However, the issues they were formed to address – how to model long-term stock market returns and how to determine appropriate reserving levels – provide a good indication of the two major dividing lines within the profession on the topic of maturity guarantees.

The first issue revolved around the two-pronged question of the stock market's behaviour and the possibility of modelling it. Benjamin's suggestion that annual stock market returns were independent and thus followed a 'random walk' – an assumption that by the 1970s was hegemonic in modern financial economics – conflicted with prior actuarial beliefs. Although actuaries tended to have diverging beliefs about investments, most agreed that investment was more akin to arts than science (see, e.g., discussion in Day, 1966). Perhaps the dominant intellectual tradition within the actuarial profession was 'fundamentals analysis' (Day, 1966). Fundamentals analysis maintains that the *value* of investments is determined by the future cash flows that it generates and should, therefore, be analysed by looking at the companies in detail. The *price* of an asset, in contrast, depends on other factors such as investors' expectations; because expectations may vary quite considerably, the asset's price may diverge from its value. An emphasis on 'fundamentals' has important implications for the usefulness of historical information. Although in this view, past company performance may be considered a useful (though insufficient) guide for expectations about future profitability and estimations of value, historical prices are not. Indeed, as Day (1966, p. 259) noted, actuaries 'find it very difficult to accept an approach depending on the past, for in so many instances the past can give no fair guide to the future, especially when Government policy and technical change can have such far-reaching effects'.

Occasionally, actuaries also drew on quite a different intellectual tradition, that of 'technical analysis' (or 'chartism'). Rather than focusing on stocks' intrinsic values, technical analysts search for patterns and trends in stock price movements, often using visual representations of the market, which can then be used to predict

future price movements (Preda, 2007). The chartist focus on stock price movements independent from fundamentals is quite contradictory to fundamental analysts' approach. In contrast to financial analysts, however, actuaries are interested in long-term aggregate stock market dynamics, which allowed elements from both approaches to be combined through the concept of economic cycles. While economic theory provided possible causal explanations for economic cycles (referring, for instance, to political cycles or processes of technological change), techniques akin to those used by technical analysts provided a means to analyse them (see Pepper and Thomas, 1973).

Drawing on early statistical research on stock markets, Benjamin sought to analyse economic cycles statistically, not with chartist techniques. It failed to convince most actuaries. Members of the first working party tasked with interrogating Benjamin's assumption of statistical independence argued, for instance, that '[i]ndependence is not a meaningful concept. ... Statistical tests are essentially shades of probability, they cannot in general confirm or reject a hypothesis with certainty' (The working part as cited in Corby, 1977, p. 260). For many, the hypothesis of independence did not match visual evidence provided by stock market charts. 'All we need', one actuary commented at a sessional meeting, 'is to look at a long-term chart of the equity price index. Traditionally ... the equity price index shows a cyclical formation ... with something like a four-yearly cycle between the peaks' (Plymen in Scott, 1977, p. 401).

Some actuaries went even further in their rebuttal of Benjamin's approach. They rejected not only his assumption of statistical independence but also questioned the possibility of adequately modelling stock markets wholesale. Francis Wales, for example, commented that:

it is one thing to postulate a mathematical model of the stock market in an attempt to determine the extent of the risk exposure, but quite another to claim that it is possible to simulate future stock market price movements. ... [L]ike the first working party I am totally convinced that it is a fruitless exercise to attempt to find a satisfactory model of stock market behaviour. ... [S]tock markets operate in a constantly evolving environment. That means that the

rules are always changing and thus the appropriate models must always be changing... (Wales in Corby, 1977, p. 288)

Similarly, another actuary asked: 'Is it really right to use the history of 1920 to 1970 to assess future changes in prices? Or have things changed fundamentally during and since this period? I suspect that circumstances are different enough now in Britain to urge great caution in this' (Grant in Scott, 1977, p. 394).

Both fundamental and technical analysis thus provided intellectual resources from the adjacent field of investment management to refute Benjamin's model. In subsequent years, alternative models were put forward. Two main approaches can be distinguished. The first accepted the need for a new approach to value maturity guarantees but rejected both the assumption of statistical independence as well as the more general probabilistic modelling framework. Dick Squires, actuary at the unit-linked fund Save and Prosper, said for instance that 'it may well be impossible to define a model to the extent of giving numerical values to the parameters that underlie it'; he argued therefore that 'an extremely simple model' would give 'adequate results' (Squires, 1974, p. 20). In his alternative model, not the unit price itself, but a 'trend line' was deterministically projected forward at an expected rate of return. At each point in time, the actual unit price would be equal to the expected unit price in 50% of the cases and would be 30% above or below the expected unit price in 25% percent of the cases respectively.

A similar approach was put forward by Corby (1977), who decided to publish his own suggested approach after his two working parties failed to reach consensus. Corby similarly suggested using a trend-line approach, but with the additional assumption that units were bought at the top of the range and sold (at maturity) at the lower end. The results produced by the model strongly depended on both the rate of return assumption as well as the size of the range within which the unit price was allowed to vary. The model was therefore rather flexible, allowing its user to adjust assumptions according to his or her expectations about economic fundamentals.

Both Squires and Corby thus suggested using a heuristic approach that would not be realistic, but that would be simple, flexible and transparent. The trend-line models, however, were vehemently opposed; reasons for doing so, however, varied

quite considerably. Some noted that the assumption of ‘buying high, selling low’ was too conservative. Others argued that the model was based on the assumption of continued economic growth; when looking at economic fundamentals, however, it ‘does not require much imagination to admit the possibility of negative growth’ (Taylor in Corby, 1977, p. 281). Most adamant in rejecting the trend-line approach was David Wilkie, whose objections were based neither on a fundamentalist basis nor on chartist grounds. A trend-line model, Wilkie argued, was ‘a malevolent deterministic model’; it was ‘as ludicrous a way of predicting share prices as to quote immediate annuity values on the assumption that everybody lives for precisely three score years and ten’ (Wilkie in Corby, 1977, p. 280). Elsewhere, he noted for instance that under the trend line approach ‘after some number of years ... the probability of the price being lower than the price at the outset was zero’, which, according to Wilkie, was ‘obviously nonsense’ (Wilkie in Squires, 1974, p. 44).

The second alternative approach, however, was not quite as radical in its rejection of Benjamin’s model – it stuck to his ‘probability of ruin’ approach – but did divert from the independence assumption. William Scott conceded that ‘chart studies of the type popular with financial journalists are of real value in detecting longer-term stock market trend’ (Scott, 1977, p. 373). Such charts were proof, for him, that stock market returns were not random, which he sought to corroborate using further statistical tests. Where Benjamin did not find any correlation between consecutive index values, Scott did find evidence for it and concluded that ‘yearly stock market movements are *not* random, but negatively correlated’ over a period of two years (Scott, 1977, p. 366) – that is, the probability of an above average return diminished if the return two years earlier exceeded expectations. He noted, however, that a ‘mathematical model’ with negative correlation ‘becomes so complicated as to be, in our view, of dubious practical worth’ (Scott, 1977, p. 375). While Scott’s own model elaborated Benjamin’s approach by fitting a lognormal distribution to the historically observed stock market returns (rather than drawing from a pool of historically experience returns), he did not seek to include negative autocorrelation in the model. Instead, he simply decided to lower the model’s standard deviation to account for the difference between observed market values and the ‘true price’ of a stock, the latter ‘very likely to be less erratic’ (Scott, 1977, p. 375). Rather than using

a standard deviation of 19% under the assumption of independence, Scott proposed to use a standard deviation of 10%.

Wilkie elaborated Scott's model. He noted that he was glad to see Scott stuck to Benjamin's general modelling framework but also noted that some aspects of it were not justified. In particular, he criticised Scott's assumption that negative auto-correlation could be approximated by simply reducing the standard deviation of a lognormal model. Scott justified this by arguing that such dampened variation would be closer to 'true prices'. Wilkie dismissed this justification by asking:

Do any of the companies that issue these policies and pay out claims buy and sell units at true prices? I thought that they bought units at market price and sold units at market price and what true prices – whatever they may be – have got to do with this I don't know'. (Wilkie in Scott, 1977, p. 409)

In a brief research note published in response to Scott's paper, Wilkie updated the former's model to accommodate for autocorrelation, noting that 'to include this relationship into the simulation program is a trivial exercise' (Wilkie, 1977, p. 20). It was an adjustment that made the model more palatable to the broader actuarial community. He furthermore incorporated additional stock market data to include data from the rather volatile period 1971-1975, which implied a significantly higher standard deviation.

The results produced by the different models diverged greatly. For an endowment policy with a maturity of ten years, Benjamin's model indicated required reserves at inception between 20%-25% (a later version of his paper presented at the International Actuarial Conference in Tokyo rather suggested reserves of 30%). Both Squires and Scott's model indicated somewhat lower reserves of around 15%. Corby suggested using calibrations of his model that would bring it in line with Benjamin's 1971 paper. Even though Wilkie allowed for negative correlation of stock market returns (which would suggest reduced reserves), his model produced the strongest reserves, significantly in excess of those put forward by Benjamin around 40%-50%.

In 1977, the issue was far from settled. A new joint Institute and Faculty working party was set up to 'recommend bases of reserving' that would 'satisfy



reasonable standards of caution and coherence’ (Ford *et al.*, 1980, p. 114). The Maturity Guarantees Working Party made every attempt at tackling the approach as rigorously as possible, or, at least, convince others they had done so. In its final report published in January 1980 (commissioned to be published in August 1978), the working party noted that ‘the amount of paper work produced, excluding enormous quantities of computer output, is well over a foot high’ (Ford *et al.*, 1980, p. 103). The report itself was considered quite important and was published with some haste: it was published ahead of schedule in a dedicated issue of the *JIA*.

The working party continued along the lines set out in Benjamin, Scott and Wilkie’s earlier work, which is not surprising considering that both Wilkie and Benjamin took part in it.<sup>12</sup> Nevertheless, the working party’s proposed model differed from earlier work in important respects. Instead of modelling stock market returns as a single stochastic process, the working party opted for a ‘two-model approach’, in which dividends would be modelled as a ‘random walk’ with a non-zero mean, and yields would be represented by an autoregressive model, fluctuating ‘around a fixed mean’. The net result was a model that represented prices as ‘a drunken stagger around a random walk’ (Wilkie interview). Not everyone agreed the model was suited for practical use. Nevertheless, it quickly became the main industry standard for evaluating maturity guarantees on unit-linked products.

## Simulation Modelling and the Broader Epistemic Field of Actuarial Science

The emergence of unit-linked insurance thus raised a series of questions about how stock market behaviour should be modelled – questions that were relatively new in the field of actuarial science in the 1970s. The topic, moreover, touched upon several broader issues within actuarial science, including, for instance, the role of computing power in actuarial work and, as indicated in Weinberg’s speech, the place of actuarial discretion in the management of life insurance business. In order to understand how

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<sup>12</sup> The working party was chaired by Hambro Life’s Alan Ford, and further included Ford’s colleague Phil Smith, David Hager, who was a colleague of Benjamin from Bacon & Woodrow, David Loades, who was a delegate from the Government’s Actuary Department, and three others.

the model of the Maturity Guarantees Working Party became the dominant exemplar for unit-linked guarantees, but not for conventional insurance, it is necessary to place the debate about maturity guarantees on unit-linked insurance within broader debates in the epistemic field. I argue, for instance, that the diverging views on the maturity guarantees issue can (at least partially) be explained by actuaries' commitment to computing technology, and their familiarity with mathematical statistics and risk theory.

As documented in great detail for the US actuarial profession by JoAnne Yates (1999, 2004) and in slightly less detail for the UK's profession by Laurie Dennett (2004, pp. 63–70), life insurance companies were amongst the 'early adaptors' of computing technology, even though in prior decades they had been slow to adopt tabulating equipment. Actuaries played an active role in advocating the benefits of computing technology. In 1953, the Institute of Actuaries set up an Electronic Computers Committee chaired by Kenneth Usherwood, an actuary at Prudential. While the committee sought to explore the potential capabilities of the various computer designs, it also 'sought to make the manufacturers aware of the needs of the actuarial profession with a view to influencing design' (Dennett, 2004, p. 66). Two years later, the Institute set up seven separate study groups, one of which was tasked with maintaining links with British computer manufacturers. Yates (1999, 2004) explains this early interest in computing technology by looking at the conditions in which many companies found themselves in post-war times. While business volumes grew significantly and the need for clerical capacity to process information increased with it, the labour market had grown increasingly tight with surging labour costs as a result. Similar conditions prevailed in the UK. In the period 1937-1953 annual premium incomes of both ordinary and industrial life assurance more than doubled (Johnston and Murphy, 1957, p. 111). Within this context, computing technology was primarily perceived as a means to speed up work and to reduce operational costs (Lewin *et al.*, 1989; Yates, 2004).

The two major proponents of simulation modelling, Benjamin and Wilkie, were also advocates of computing technology. Particularly Benjamin's professional career is illustrative of the close ties between insurance and computing companies.

Benjamin, who was employed by Prudential, went back to Cambridge (where he, like many fellows, had obtained his first degree in mathematics) at the insistence of his mentor Kenneth Usherwood to take a course in programming. He later briefly worked for Ferranti Computers as a contributor to the Cambridge University Atlas project to ‘develop his knowledge of computing’, before moving in 1962 to the actuarial consulting firm Bacon & Woodrow where he would remain an active advocate of computing technology (Lever, 1992, p. 383). In 1961, Benjamin set up and ran a programming course at the Institute’s Students Society, consisting of ‘12 fortnightly lectures each of two hours, with several hours of homework between lectures, and a final practical of two sessions on a machine’ (Benjamin, 1964, p. viii). Hoping to ‘fill perhaps 25 to 30 places’, the course was oversubscribed with ‘over 70 applications’ (Benjamin, 1964, p. viii). Wilkie had ‘worked with programming on computers one way or another’ ever since the company he worked for at the time, Scottish Widows, had purchased a computer in about 1960. A few years later, he would publish a rather bulky paper describing the ‘procedures adopted by [his] company in setting up a computer system with magnetic tape files to provide valuation and other statistical information for ordinary assurances’ (Wilkie, 1964, p. 89). Although less active as an advocate of computing technology within the profession, Wilkie did have specialist knowledge of statistics, which aroused his interest in the affordances of the computer: he had taken ‘a specialist course on statistics’ and had therefore done ‘a lot more statistics than most actuaries’ (Wilkie interview). After having met Benjamin in the latter’s employment at Ferranti, the two became friends. As Wilkie recalls, Benjamin ‘was very good at seeing what you could use the computer for’ and Wilkie soon ‘started noticing’ that you could ‘do a lot of mathematical things that were ... obviously not impossible to do by hand, but that were not worth doing by hand’ (Wilkie interview).

Initially, the impact of computing technology on life insurers’ organisational practices remained limited. As Yates (1999) puts it, pre-existing practices ‘structured’ how computers were adopted. In the early years, the costly and bulky mainframe computers were mainly used as ‘data processing’ devices. In so doing, computing technology often struggled to live up to the promise to reduce the cost of clerical work. As Benjamin noted: ‘at any point of time a conventional costing has

usually shown that a changeover to computers is at best only marginally worth while' (Benjamin, 1966, p. 134). This raised questions about the usefulness of computing technology and urged advocates to find novel uses. In 1963, Benjamin published what he called 'a propaganda attempt to counterbalance the emphasis on data-processing applications which there has been in the past', which he regarded 'an unfortunate mistake'; indeed, he continued, '[c]omputers can be regarded as glorified desk calculators or high-speed punched-card machinery but this misses the real potential of the qualitative difference between computers and earlier machinery' (Benjamin, 1963, p. 7). Wilkie similarly 'started looking around for ways of using it [computing technology], rather than just replicating the previous clerical systems' (Wilkie interview). Advocates of computing technology thus perceived simulation modelling as a potential justification for expenses; the maturity guarantees on unit-linked policies appeared as an important problem that could validate the need for simulation modelling.

Benjamin and Wilkie's proposals fitted somewhat awkwardly with the profession's emphasis on expert judgment and the discretionary space typically afforded to actuaries. The two actuaries perceived 'formalisation' as an advantage because it allowed for the degree of actuarial prudence to be measured explicitly. When the Maturity Guarantees Working Party published its report, most actuaries accepted there were some benefits to simulation modelling. Yet, many remained sceptical about extrapolating history into the future. Such an approach depended on a 'belief' in the 'uniformity of nature', the 'belief that everything that has happened or will happen is an instance of some general law to which there are no exceptions' (Limb in Benjamin *et al.*, 1980, p. 228). Actuaries tended to agree, however, that at least some of the observed variation was non-random. In replying to Benjamin's 1966 paper, Bobby Beard, a general insurance actuary (this was rather uncommon) from Pearl Assurance who had co-authored a textbook on risk theory, argued that Benjamin's enthusiasm for computing was 'reason for a cautious approach to his ideas'. According to him, actuarial judgment had previously served an important purpose in the context of life insurance:

Actuarial techniques, as developed for life insurance purposes, had been developed on the principle of making calculations on the basis of expected values of the various functions entering into the calculations and relying on judgment to allow for variables not specifically included in the underlying models. It had generally been considered that the non-random variation was considerably more significant than the random variation in the functions used, for instance, mortality, and thus judgment was a necessary part of an actuarial knowhow. (Beard in Benjamin, 1966, p. 181)

Beard hit upon a crucial point. Diversifiable risk, such as mortality risk, had traditionally been the bigger risk in insurance (see chapter 2). With the emergence of unit-linked insurance, however, non-diversifiable risk became increasingly important. Although variation in capital market returns seemed random, the question remained to what extent actuarial judgment was needed to account for non-random variation. It was a question that concerned not just the maturity guarantees but also the nature of actuarial expertise and the constraints on actuarial discretion that came with it.

This picture was further complicated by the practical need for company actuaries to decide on appropriate levels of reserve. Many of the actuaries working at unit-linked companies initially responded to Benjamin's paper by emphasising that past experience could not simply be extrapolated into the future and that reserving therefore required expert judgment about what the future would hold. This is not surprising, considering the fact that the new simulation models implied that reserves had been inadequate – a message that many actuaries were not keen on delivering to company management.

In the 1970s, moreover, few actuaries were familiar with the simulation techniques deployed by Benjamin and the 'risk theory' from which it derived. The first English textbook on risk theory was published in 1969 and was co-authored by Bobby Beard and two Finnish colleagues, Teivo Pentikäinen and Erkki Pesonen. Risk theory was first discussed at the Faculty of Actuaries in 1970 when the statistician Robin Plackett exposed some of its elementary concepts in an address to

the profession.<sup>13</sup> In response to Plackett's talk, one speaker expressed a feeling he suspected some of the other actuaries present would share with him: 'the feeling of being lost in this particular subject' (McKinnon in Plackett, 1970, p. 352). The fact that the mathematics underpinning risk theory and the techniques required for its implementation through computer simulation were foreign to many actuaries also surfaced repeatedly in the sessional meetings at which the maturity guarantees were discussed. In response to Scott's paper, for instance, one actuary noted that 'mathematical concepts beyond my comprehension are used' (Russell in Scott, 1977, p. 400). At the Institute, Colin Seymour recalled, how in the early 1970s the 'Scandinavians with their modern risk theories were an unheard-of mystery', and 'perhaps', he continued, 'many of us are still rather daunted by such high level statistics' (Seymour in Corby, 1977, p. 284).

Actuaries' unfamiliarity with the mathematical and computational techniques used by Benjamin led many to use the more familiar 'deterministic' approaches. Dick Squires, for instance, was in need of a quick, practical solution to the problem that he could use to convince the management of his firm, Save and Prosper, of the need for additional reserves. He therefore preferred a model that was 'not intended as an accurate representation of market behaviour, [but] simply as a tool for estimating premiums and reserves'. Nevertheless, despite the relative absence of familiarity with simulation modelling and risk theory and opposing views on the modelling of unit-linked guarantees, the modelling work of the Maturity Guarantees Working Party became widely accepted in the actuarial field as the dominant problem solution. In the next section, I examine the strategies that were deployed to achieve this.

## Generating Consensus in the Epistemic Field

The entanglements between the epistemic field of actuarial science and the market field of life insurance provide a strong push towards resolving conflicts such as the

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<sup>13</sup> British actuaries might have also encountered risk theory in an international context: the International Actuarial Association founded a group focused on general insurance (ASTIN) in the 1950s. In its journal, the ASTIN Bulletin, and its meetings risk theory was frequently discussed.

one about unit-linked guarantees. As noted in chapter 2, with the emergence of the ‘freedom with publicity’ regime in the late 19th century, the actuarial profession acquired ‘epistemic’ and ‘supervisory’ authority and actuarial science became ‘nested’ into the market field of life insurance. The legitimacy of actuaries’ authority was grounded in their ability to check opportunistic behaviour with the development norms through rational argument.

The issue of maturity guarantees posed a potential threat to the legitimacy of actuarial expertise. Pressure on the actuarial profession had mounted by the mid-1970s. After a stock market slump, several insurance companies that had sold ‘guaranteed income bonds’ got into trouble. In particular, the collapse of the mid-sized life insurance fund Nation Life contributed to public pressure on the lack of formalised actuarial knowledge. For example, *The Economist* (Anon., 1974, p. 86) cited the ‘absence of an actuarial code of practice’ as an ‘important reason why these companies boomed and bust’. It also led to pressure from the Department of Trade and Industry, which was the formal insurance regulator, and the Government Actuary’s Department, which carried out the limited supervisory activities and advised on regulation (see: Daykin, 1992; see also chapter 5). Representatives from the Government Actuary’s Department participated in the profession’s sessional meetings, where they emphasized the need for closure, but refrained from advocating a particular approach. In an exemplary case, for instance, the Government Actuary Edward Johnston commented in the discussion of Corby’s paper that:

that there is no general agreement on the mechanical models which should be used for assessing ... reserves. I am certainly not going to venture any opinion on which mathematical model is right, but there does have to be a practical answer to this question because companies do have to set up reserves of some size or other.  
(Johnston in Corby, 1977, p. 284)

The issue of maturity guarantees potentially threatened not only the legitimacy of actuarial expertise but also the financial wellbeing of companies that had little to do with them. Wilkie estimated, for instance, that maturity guarantees were indeed a collective problem. He estimated that roughly £2,000 million worth of maturity guarantees had been written and that companies were ‘short of around £1,000 million of reserves’. The maturity guarantees that had already been written,

he continued to argue, therefore posed a ‘practical problem’ for both the ‘Department of Trade’ as well as for ‘other life assurance companies because ... they are going to foot the bill when the companies writing this business – if they go bust – do go bust. So it is up to all life offices as well to think about how it should be done’ (Wilkie in Corby, 1977, p. 412). This further emphasised the need for closure.

Many also agreed, however, that a resolution should be based on the merit of argument. Hambro’s actuary Phil Smith argued, for instance, that ‘regulations should not be made until we have solved the problem’ (Smith in Corby, 1977, p. 275); similarly, Peter Turvey expressed the hope that ‘common agreement’ would be found ‘before we are compelled by new regulations’ (Turvey in Corby, 1977, p. 287). To understand how the debate was resolved, therefore, it is important to take a closer look at the discursive interactions taking place in the sessional meetings. Many of the arguments that were put forward did not only address the content of the mechanical models in themselves, but placed such models in the broader context of actuarial practice and sought to extend existing norms and practices through analogical reasoning in an assessment of the proposed methods.

Consider for example this common defence of the deterministic approach by Andrew Wilson. Wilson argued that there was much to be said for the simplicity of the deterministic approach. Reserve valuations, after all, were at least partly intended to convince external stakeholders of the adequacy of a firm’s reserves. A ‘method that is readily checked by another actuary’, which allowed ‘the relative strengths of two offices’ to be compared ‘easily’, and which could be ‘understood by lay observers’ was to be preferred above more complex simulation models. Furthermore, Wilson argued that a simulation approach would have important implications for how funds were managed: the necessary reserves would fluctuate with changes in the stock market index, forcing insurers to increase reserves in times when the index was low and allowing them to decrease them when the latter was high. In contrast, a simpler deterministic approach ensured that ‘reserves are stable and do not fluctuate violently’ and allowed them to ‘increase gradually while the market is high and decrease slightly when it remains low’ (Wilson in Corby, 1977, pp. 287–288). For



Wilson, it was primarily the simplicity of evaluation that should be retained when extending actuarial knowledge to the issue of maturity guarantees.

In sanctioning the simulation modelling approach, proponents also tended to appeal to recognised professional norms. In the discussion of Corby's paper, for instance, Benjamin appealed to the norm of actuarial prudence to persuade others of the need to adopt a 'random walk' model:

When doing research there is a duty to be cautious. The profession is faced with one model and method – that is to say the random walk approach – which has been written up, and other methods which have not been subjected to publication and which, from a brief description, do not sound coherent in the way that I have defined. The random model is apparently more cautious and hence it seems to me to be the only one which is professionally justifiable in this situation. Unfortunately, it leads to very large reserves and it is sometimes condemned as over-cautious, for that reason, but that of course is nonsense; it is inverted logic. (Benjamin in Corby, 1977, p. 280)

Similarly, Wilkie drew an analogy with existing actuarial practices in criticising Scott's adjustment to the standard deviation of annual stock market returns to account for long-term autocorrelation. He proclaimed that:

there is an awful lot of literature, mostly American but also quite a lot of British literature, about the movements of prices of ordinary shares. There has been some criticism of using the period 1919-1970, or indeed any past history to forecast the future. Now, I would suggest that this is equivalent to saying that it is a very bad idea using past experience for mortality rates; what we should do is take a guess at what mortality rates are going to be and then, as Dr Scott has done [in the case of stock market returns], should just halve them to allow for forecasting!' (Wilkie in Scott, 1977, p. 409)

Actuarial knowledge had attempted to understand the future by looking at past statistics ever since it started using mortality tables, Wilkie suggested, and there was no good reason to do so otherwise when looking at investment returns.

Crucial in sanctioning the simulation modelling approach, also, was its affiliation to statistics. Historically, Alborn (1994) argues, actuarial science's alliance with statistics enhanced the status of the actuarial profession. To the extent that this

status has provided (and continues to provide) a resource for the profession to defend its jurisdictional claims in the context of life insurance, it also allows for the sanctioning of particular practices within the profession. For example, proponents of the simulation modelling approach, such as Wilkie, argued that adherence to deterministic techniques threatened the profession's credibility: 'We still teach life contingencies in a purely deterministic way', he noted, 'and if we continue to do so we shall be ridiculed by statisticians in every country' (Wilkie in Corby, 1977, p. 280). Elsewhere, Benjamin said that the scientific criteria of statistics should apply also (albeit perhaps in weak form) to actuarial practice: 'any solution which the profession were to adopt should be reasonably acceptable from a statistical point of view' (Benjamin *et al.*, 1980, p. 229). However, Benjamin noted, 'it would be very unfortunate if a statistician outside the profession were to come along with a solution which the profession would then examine in arrears'. In other words, the issue was not simply one of whether actuaries would be able to understand the mathematics involved: they were the experts whose task it was to translate general statistical theory into practical applications, not the statisticians. If statisticians would beat them to it, Benjamin implied, it would harm the profession's status.

Even though Benjamin borrowed techniques from the relatively 'foreign' risk theory, statisticians' approval of those techniques meant they were considered legitimate, albeit perhaps in need of revision. By the time the Maturity Guarantees Working Party published its paper, an important concession was made: its model allowed for negative correlation and modelled stock market returns as two separate processes of dividend yields and capital gains. The model successfully convinced some of those who had previously been opposed to the simulation approach (although some would have undoubtedly retained their initial scepticism). At a sessional meeting at the Institute, Francis Wales, who had 'criticised previous attempts to construct accumulation unit price models for failing to differentiate between the components of price movements, i.e. capital values and dividend yields', now said that the working party's suggested model seemed 'eminently reasonable, and certainly overcomes my objections to earlier work by Messrs Benjamin and Wilkie' (Wales in Ford *et al.*, 1980, p. 221).

## Living in a Stochastic World

It is not easy to assess what the impact of the Working Party's report was and to what extent its approach was accepted as being appropriate, but the available evidence suggests that although maturity guarantee business was eventually recognised as prohibitively expensive, uptake of the working party's model remained, at least initially, only marginal. In opening the discussion of the working party's report at the Faculty of Actuaries in October 1980, ten months after it had been presented at the Institute, one of its members, Ben Rowe, noted that he had studied the regulatory returns of 22 companies and found that only two companies had used the working party's method. Many actuaries appeared to have been concerned with the limited practicality of the model – for instance because they had insufficient familiarity with programming or the model's underlying mathematics so that they could adjust it to the specific characteristics of different portfolios – and preferred some deterministic approximation of the model over the stochastic one. For Rowe, however, the fact that two companies had succeeded in implementing it was proof that 'the method is a practical one' (Rowe in Benjamin *et al.*, 1980, p. 214).

The working party's model would nonetheless have important effects. First, the working party's model provided an 'exemplary problem solution' to investigate financial risk in contexts different from maturity guarantees. The financial market volatility of the 1970s and 80s raised new questions about the feasibility of different investment strategies. In the years after publication of the 1980 Working Party model, Wilkie continued its development in a series of papers. His model – the 'Wilkie model' – was the first 'stochastic model' of financial risk that was widely used across the industry. Part of its success was that the model was specifically designed for long-term actuarial applications, 'was relatively easy to apply – it could be coded into a spreadsheet' and was 'consistent' with the 'prior belief' that stock markets follow a mean-reverting process (Jakhria *et al.*, 2019).

A second effect was that after the publication of the working party's report, it became widely accepted that unit-linked contracts with maturity guarantees – at least in their present form – were much more costly than was initially assumed (and

indeed more costly than implied by Benjamin's initial modelling work). Consequentially, the volume of such policies diminished rather quickly. Although it is likely the working party's model contributed to this, the precise extent in which it did so is uncertain. David Wilkie suspects, for instance, that the decisive moment was not the publication of the working party's report itself, but would come later when Standard Life – Wilkie's new employer after he left Scottish Widows – declined to participate in the underwriting of one of the major unit-linked offices founded by Weinberg, Hambro Life. At the time, Wilkie noted, it was common practice for institutional investors to take small stakes in a company when it could not sell all its shares to the public. When Standard Life's investment manager asked Wilkie for his opinion on Hambro Life, the latter replied: "I think we shouldn't touch it", because Hambro had a lot of this [maturity guarantee] business, I knew that it was risky.' Wilkie suggests that 'since it was Standard Life' – a leading Scottish life office – 'those in the market thought that there might be something serious about it – one insurer not being sure about another' (Wilkie in personal communication). It is, of course, difficult to assert the precise extent to which this incident influenced general market practice.

While this was intended, the model also produced an unintended effect. The maturity guarantees were an important component of the marketing of unit-linked insurance. Unit-linked offices, therefore, started looking for an alternative, less costly means of providing such guarantees. In a paper presented to the Society of Actuaries in Ireland, the Irish actuary Colm Fagan (1977) suggested that it would be possible to adopt an investment strategy that would 'immunise' the risk embedded in the maturity guarantees, an approach that some would later recognise as remarkably similar to models in modern financial economics to price options (see chapter 5). Several actuaries picked up on Fagan's suggestion and his 'immunization' approach was, indeed, studied by the Maturity Guarantees Working Party. The latter concluded, however, that it 'does seem to have serious practical disadvantages because it depends upon several underlying assumptions ... [but] merits further investigation' (Ford *et al.*, 1980, p. 112). As discussed in more detail in chapter 5, the push for new approaches to insurance that combined elements of unit-linked

insurance with maturity guarantees anticipated later developments in the actuarial machinery.

## Conclusion

In this chapter, I have argued that the introduction of simulation modelling as a means to evaluate financial risk was the result of a series of contingent circumstances. The rapid proliferation of unit-linked insurance – a particular blend of insurance and investment – in the 1960s and 70s posed a series of epistemic problems to the actuarial profession, which actuaries initially sought to solve by drawing on traditional techniques of deterministic, expected value calculations. Within this context, Benjamin’s proposal to approach things differently led to a series of heated controversies in which actuaries debated the appropriate place of mathematical statistics, computer-based simulation and risk theory in the epistemic field of actuarial science. Crucial in these debates were considerations of the professional jurisdiction of actuaries and how to best strengthen its claims (Abbott, 1988). The modelling work of Wilkie and Benjamin was eventually accepted as a problem solution for the issue of maturity guarantees, and even though Wilkie’s later models became widely used for some specific purposes, its influence on the epistemic field remained somewhat limited, at least initially so. Actuaries thus retained their role as custodians of surplus in a period where increased financial market volatility was beginning to raise new questions about actuaries’ ability to know the future.

Quite apart from its empirical relevance, this chapter shows how, in a profession-based model of governance, where the epistemic authority of the actuarial profession is bestowed upon it by the state, actuarial expertise contributes to mitigating the financial consequences of uncertainty. Within this model, actuaries retain epistemic authority as they have the power collectively to determine how insurance liabilities should be evaluated. In exercising this discretion *collectively*, actuaries seek to establish a degree of commonality in knowledge practices by communicating through specific channels that are given shape to represent such scientific norms and values as ‘publicity’, ‘universality’ and ‘rational argument’.

Individual actuaries may deviate from standard practice but might lose status in so doing. Although regulators retain political power (they can decide what courses of action are allowed and which ones are not), their epistemic role is reduced to that of auditor: they review firms' actuarial reports. When novel objects of concern emerge (such as unit-linked policies with maturity guarantees), regulators may push actors in the epistemic field to decide how particular objects are to be accounted for and do not decide on this themselves; it is a power they have delegated to the profession. In exercising their epistemic authority, actuaries thus contribute to making and sustaining the social order in the market field.







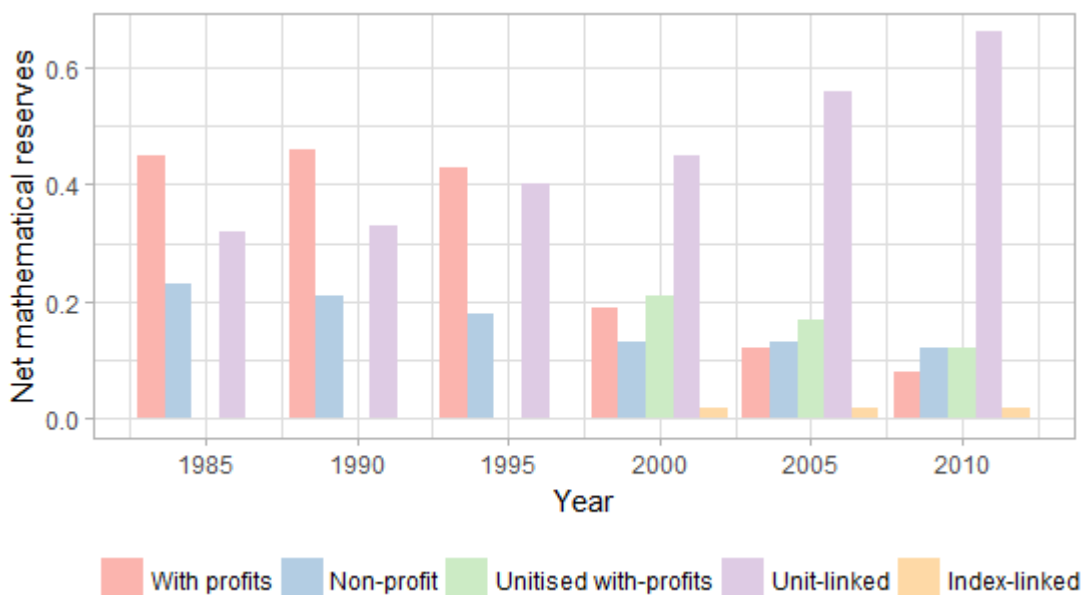
## Chapter 4

# Competition, Change, and the Making of a Crisis

In the previous chapter, I argued that technological developments allowed new unit-linked insurance companies to challenge the dominant position of conventional life insurance arrangements. The main aim was to describe key debates in actuarial science that emerged in response to the introduction of unit-linked insurance. In this chapter, I examine how the emergence of unit-linked insurance and the novel practices of evaluation that came with it influenced competition in the market field. I argue that the challenge posed by the newly established unit-linked offices fostered changes in the epistemic machinery underpinning conventional insurance arrangements that would ultimately contribute to their decline and perhaps even demise (see figure 4.1).

Key in this chapter is the story of the Equitable Life Assurance Society (or simply ‘Equitable’), which (as noted in chapter 3) had been the first life insurance company to adopt ‘scientific principles’ as the basis for its management in the late eighteenth century. By the mid-twentieth century, Equitable was a mid-sized company, selling primarily pensions related products. The company’s fate, however, was intimately entangled with the fate of conventional insurance arrangements, even if many of its practices appeared somewhat idiosyncratic by the end of the twentieth century. The company’s downfall, which was heavily reported on in British media, raised important questions about the legitimacy of conventional actuarial practice, and ultimately fostered the adoption of new techniques such as those borrowed from financial economics. Even if Equitable’s practices were considered somewhat idiosyncratic, its story says much about wider changes in the life insurance industry.

This chapter, then, examines how the challenge of unit-linked insurance shaped conventional insurance practice. First, I describe some of the institutional features central in the field of life insurance and show how unit-linked insurance sought to challenge them. I then examine how competition amongst insurers was



**Figure 4.1** Mathematical reserves backing different lines of business, 1985-2010. Source of data: Almezweq (2015).

organised, and the role therein of specific ‘devices’. Next, I describe how increased competition led to a wave of mergers and the ‘demutualisation’ of long-established mutual offices, which strengthened insurers’ focus on shareholder value. Finally, I move to the story of Equitable, which is divided across two sections. First, I describe the evolution of its practices throughout the second half of the twentieth century; and, second, I investigate the immediate causes of the company’s financial problems and describe how it was interpreted as a failure of traditional actuarial methods.

## New Entrants and Shifting Market Barriers

Competition is one of the main threats to profitability. As field theory suggests, firms thus have an important incentive to attempt to control competition (Fligstein, 2001). For much of the nineteenth and early twentieth-century incumbent life insurers have done so with remarkable success, which is reflected in the relative stability of the market. In this period, there were a large number of offices in operation, many of which were already established in the early decades of the nineteenth century. In the first half of the twentieth century, some degree of consolidation took place. Although the number of offices transacting life insurance business increased, the share of total

business transacted by the ten largest offices increased from 46.4% in 1913 to 57.8% in 1953.

The market for life insurance, however, was geographically dispersed; many offices were closely tied to specific locations, which was reflected in names like London and Lancashire Life, Manchester Life, and Edinburgh & Glasgow. There was some degree of nation-wide competition, but the competition was strongly regulated and occurred among well-established offices with long histories (see table 4.1). The relative stability of the UK life insurance market that continued into the second half of the twentieth century was also reflected in a relative stability in actuarial expertise, which is well captured by Frank Redington, one of the most prominent British actuaries in the twentieth century, who wrote in the early 1980s that '[t]he actuary of 1945 was closer in spirit to the William Morgan of 1800 than to the actuary of today' (Redington, 1981).

This relative stability suggests that there were important market barriers and mechanisms that stabilised competition. Formal barriers, however, were initially very small. Before 1967, there was no formal system of 'authorisation'. Anyone with access to £50,000 starting capital wishing to sell life insurance could do so in principle. Legal requirements became more stringent only towards the latter decades of the twentieth century, first, in 1967, and later with the Insurance Companies Act of 1974. The new requirements were, however, relatively mild: new entrants were required to have paid-up capital of at least £100,000 and needed to have their business plan approved by supervisors from the Department of Trade. It needed to show, moreover, that its management was 'fit and proper' (Franklin and Woodhead, 1980).

Although formal requirements were low, there were nonetheless important barriers to entry. For instance, life insurers organised themselves collectively in the Life Offices Association (the forerunner of the contemporary Association of British Insurers), which functioned as an 'internal governance unit' (Fligstein and McAdam, 2012) by regulating sales commissions. It set an upper limit to sales commissions, which prevented individual offices from aggressively expanding their market share by paying sales agents in excess of market commissions (Carter and Falush, 2009,

pp. 154–155). Another contributing factor was that actuarial claims to the technical expertise required for running a life office are likely to have contributed to the industry’s stability. Actuarial training was provided to students in their employment at companies. Although there were a small number of actuarial consultants advising pension schemes (most schemes subcontracted pension contracts to life insurers), most actuaries were therefore trained at established life offices, with the total number of qualified actuaries not exceeding a thousand until the 1960s (Dennett, 2004, pp. 196–197). The fact that actuaries were trained at companies and few in numbers is likely to have complicated the acquisition of actuarial expertise for new entrants.

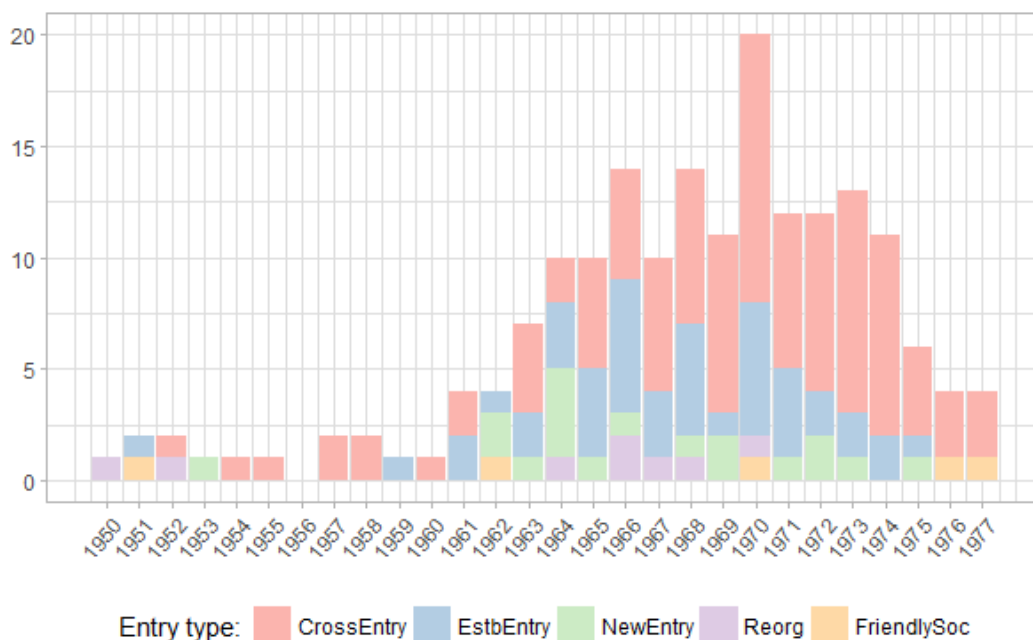
**Table 4.1** The ten largest life offices measured by total sums assured in 1913 and 1953.

Top ten in 1913	Est.	Type	Top ten in 1953	Est.	Type
Prudential	1848	Prop	Prudential	1848	Prop
Scottish Widows	1815	Mutual	Legal & General (previously 11)	1835	Prop
Alliance	1824	Prop	Norwich Union	1808	Mutual
Norwich Union	1808	Mutual	Sun Life (previously 12)	1810	Prop
North British	1823	Prop	Standard Life	1824	Prop
Commercial Union	1862	Prop	Pearl (previously 21)	1857	Prop
Scottish Provident	1837	Mutual	Co-operative (previously 63)	1867	Mutual
Standard Life	1824	Prop	Scottish Widows	1815	Mutual
Gresham	1848	Prop	Commercial Union	1862	Prop
Phoenix	1782	Prop	Refuge (previously 16)	1864	Prop

Rankings were derived from Johnston and Murphy (1957, p. 136). Information about the offices was obtained from Alborn (2009, Appendix 1).

Economists have pointed to some important economic barriers too. First, life insurance is characterised by increasing economies of scale (Hardwick, 1997). The expenses of large offices are relatively small compared to the cost of running a smaller one, for instance, because it is relatively more expensive for smaller companies to sustain a distribution network (Ward, 2002). A second economic barrier is a phenomenon known as ‘new business strain’. While revenue from

traditional ‘regular premium’ business (as opposed to ‘single premium’) only materialises over long periods – and are uncertain – the costs of such business (e.g. commission to sales agents) tend to be concentrated at the contract’s inception. Writing large volumes of new business can thus be rather costly, which dampens companies’ growth potential (Franklin and Woodhead, 1980, pp. 94–95). Combined, the new business strain and economies of scale put larger offices at a structural advantage, while smaller offices were left to target specific niches.



**Figure 4.2** New entrants in the UK market for life insurance, 1950-1977. CrossEntry: firms already underwriting insurance either domestically in general insurance, or abroad. EstbEntry: entrants owned by parent companies previously not involved in insurance. NewEntry: entrants without already established parent companies. Reorg: firms that are the product of a reorganisation of a life office. These are strictly not new entrants. FriendlySoc: companies previously underwriting industrial insurance entering the ordinary life insurance market. Source of data: Franklin and Woodhead (1980), p. 97.

A final barrier was formed by the economic advantages derived from having an ‘estate’. Estates were reserves that belonged to no group of policyholders in particular, but to the company as a whole, and were built from taking ‘tiny slices’ of a company’s profits on non-profit business. An interviewee who had been appointed actuary of a large mutual office said for instance that before the company was ‘demutualised’ (a topic that will be discussed below), it had an estate of £3bn while

having total assets under management of £10bn. The estates were, in a sense, passed on from previous generations of policyholders to the next; the responsible actuary therefore not only had a duty, in law, to the current generation of policyholders but also to future generations. This interviewee, moreover, felt a sense of ‘loyalty’ to ‘his predecessors’, who he said through ‘careful husbandry’ had ‘built up the estate’ (Forfar interview). Estates provided companies with several advantages, including increased flexibility in bonus distribution policies and the ‘smoothing’ of policyholder benefits, and thus put incumbent insurers at a structural advantage versus younger challenger firms that did not have the benefit of legacy estates.

The relatively stable structure of competition, however, would be shaken in the 1950s and 60s. As shown in figure 4.2, the number of new entrants in the UK’s life insurance market surged in the 1960s and 70s, particularly due to the emergence of new subsidiaries either of companies already writing insurance business or of already established companies not involved in the insurance business. Particularly the emergence of unit-linked insurance, which formed an increasingly large share of total life business, had a strong impact on the industry. In 1968, the largest share of new business premiums went to Abbey Life, the first unit-linked office founded by Mark Weinberg (see chapter 3). Save & Prosper and International Life – two of the other major unit-linked offices – similarly featured among the top ten companies with the highest premiums deriving from new business (Richards and Colenutt, 1975, p. 157). Seven years later, in 1975, the picture had changed even further. The ten companies accumulating the largest shares of new business was now spearheaded by Hambro Life, the second of Weinberg’s companies, and further included Abbey Life, Hill Samuel and Property Growth – all selling unit-linked insurance (Richards and Colenutt, 1975, p. 158).

An important factor in the success of unit-linked insurance was the fact that life insurance enjoyed several significant tax advantages through the ‘Life Assurance Premium Relief’. It meant that it was relatively more attractive to save via life insurers rather than putting the money directly in a unit trust. It also raised questions, however, to what extent unit-linked insurance should be treated as insurance and to what extent as an investment. In 1971, the Department of Trade and Industry, which

was the insurance regulator at the time, commissioned a report by Hilary Scott, a non-executive director of Equity & Law and the Bank of Scotland. When presenting the committee's findings to the Faculty of Actuaries in 1973, Scott (1975) noted that a third of life insurers' total annual premium income was generated by unit-linked insurance. One member of the committee argued that the insurance and investment component of unit-linked insurance should be regulated separately. Other members of the committee, however, agreed that unit-linked insurance should remain under the auspices of the actuarial profession, the Department of Trade and Industry and, indeed, the Government's actuarial department (Scott *et al.*, 1973). The tax advantage that for a long time had worked to the advantage of incumbent life insurance companies now facilitated the emergence of the challenger firms.

Crucially, the structure of unit-linked insurance allowed challenger firms to circumvent some of the market barriers described above. Because unit-linked insurance pushes much (though as seen in the previous chapter not always all) of the investment risk to the level of the individual, it is argued to be much less capital intensive than some forms of with-profits insurance. This was one of the reasons, according to Weinberg, why Abbey Life was able to grow rather fast. In the 1973 lecture quoted in the previous chapter, Weinberg said:

The first unit-linked policy introduced in this country was introduced not for any technical actuarial reason but for a very valid marketing reason, namely that a newly established life office ... recognised that in a savings-orientated market it was difficult for it to compete in the absence of an estate which enabled it to quote competitive with-profits bonuses, and this problem was neatly finessed by linking the policy to units of a Unit Trust. (Weinberg, 1973, p. 16)

Weinberg also noted that if it were not for the sum of starting capital required (the £50,000 threshold) to be relatively small, his company would not have been founded in the first place. The sum would indeed have been rather low for new life offices writing conventional business, he conceded. Ten years earlier, a paper entitled 'The Problems of a New Life Office' was presented at the Institute, which argued that a shortage of capital resources was the 'most important of all the problems' of a new office (Crook, 1963, p. 226). The lower need for capital to

support unit-linked business, however, meant that new companies were enabled to write more business on a smaller capital basis. To take the example of Abbey Life again, it managed to grow significantly without having to increase its capital base, which it did once it was ‘taken over ... only because it looked rather off to be writing quite a lot of business on a very small issued capital’ (Weinberg, 1973, p. 6).

Unit-linked insurance also circumvented the problem of new business strain. While in conventional insurance, expenses were typically spread out over the life span of a policy, most of the new unit-linked offices would deduct all or most of the initial expenses from the first premium(s) paid, leaving only a rather small amount of it for the purchase of units. This practice, known as ‘front-end loading’, reduced the initial cash flow strain produced by the issuance of long-term contracts.

Unit-linked insurance thus allowed challenger firms to undermine key market barriers, which – strengthened by their ties to actors in adjacent fields (banks and unit trust funds) – were relatively uninhibited in so doing. At the same, a series of policy reforms reshaped the regulatory structure of UK’s long-term savings markets, particularly the market for pension savings, which created new business opportunities for long-term insurers (Hannah, 1986; Waine, 1992; Langley, 2006; Langley and Leaver, 2012). In the first half of the twentieth century, insurance companies became important providers of retirement annuities (a post-retirement product that typically provides a guaranteed income until death) and investments to occupational pension schemes, which provided an attractive vehicle for saving – due to tax advantages – to an increasing share of the population, a market that was dominated by Legal & General (Hannah, 1986, p. 37). Only a few of the larger schemes were self-administered and these would purchase annuities from insurers to pass on the mortality-related risks of the post-retirement phase. The market for insurance products in retirement income provision expanded in 1956 when the right to tax relief on retirement annuities was extended to self-employed workers, which included such professionals as solicitors, doctors and accountants; in the following year, many companies started offering individual retirement annuity policies. In 1978, when pension policyholders were allowed to purchase annuities in the ‘open



market' (i.e. from companies different from the ones that provided the pension), competition among insurers strengthened (Hannah, 1986).

Another significant change occurred under the UK's new right government and the implementation of its 1986 Social Security Act. While previous Conservative governments had sought to promote saving through occupational pension schemes, the Thatcher administration steered towards increased individual control over pensions and sought to strengthen competition in the long-term savings industry (Waine, 1992). The Social Security Act, therefore, provided strong incentives to opt out of the redistributive, government-led State Earnings Related Pension Scheme, gave workers the possibility to opt out of previously compulsory occupational pension schemes and introduced 'personal pensions' as an alternative. Overall, changes in the UK's retirement income system had important implications for the insurance market: while the total market for pension savings increased significantly, increased individual control over pensions since the 1980s strengthened competition among insurers seeking to benefit from it.

These changes in government policy strengthened competition amongst life insurers for new business. Some see the increased competitive pressures as an important contributing factor to the 'pensions misselling scandal' of the late-1980s, for which insurers were fined over £10bn (Black and Nobles, 1998; Brannan, 2017). Insurers were accused of having induced policyholders to give up attractive defined-benefit pensions in exchange for much riskier personal pension plans. Although the precise causes for the pensions misselling scandal are complex and besides the focus of this chapter, it nevertheless indicates that the existing institutional arrangements through which competition was historically stabilised were increasingly undermined from the late 1980s onwards.

## Market Devices and Competition

The challenge posed by unit-linked insurance firms and changes in the UK's retirement income system thus fostered increased competition amongst insurers. In this section, I examine the organisation of competition among insurers and the role of specific devices therein. The term device is used here in the same sense as it is used

in STS-inflected sociology – as ‘a simple way of referring to the material and discursive assemblages that intervene in the construction of markets’ (Muniesa, Millo and Callon, 2007, p. 2). These assemblages produce attachments to particular products and aid in the creation and sustenance of market boundaries. The point of focusing on the material devices of competition is to show not only that the introduction of new insurance arrangements may foster competitive pressures and may thus lead to lower prices, but also that it may lead to changes in the nature of already existing life insurance arrangements.

Among the most important devices in conventional life insurance is the reversionary bonus, which (as noted in chapter 3) became a potent ‘marketing device’ after its inception in the late eighteenth century, even if it was simply intended as a tool for distributing surplus (Alborn, 2002, 2009). Operating bonus schemes was, however, no small task and the necessary calculations required the labour power of substantial clerical machinery. Bonus declarations thus necessarily occurred with long intervals, which, somewhat ironically, contributed to life offices’ increased emphasis on investment. The infrequent bonus declarations, as Alborn notes (2002, 2009), were ‘dramatic events’, which had several unintended consequences. The marketing role of bonus declarations, for instance, put pressure on life offices to sustain attractive bonus rates, leading some offices to ignore actuarial reports of deteriorating financial positions – reports that in early years were kept confidential. After the 1870 Assurance Companies Act, however, periodical valuations were to be made public, allowing interested policyholders to scrutinise in more detail the meaning of such declarations. The increased scrutiny reduced the importance of bonus declarations as marketing devices, which was reflected in a reduction of bonuses, the degree of fluctuation therein and, with the introduction of new arithmetic technology, the length of the intervals between them (Alborn, 2002).

While the importance of reversionary bonuses as marketing device declined, the emphasis on bonus rates remained. From the mid-twentieth century onwards, for instance, comparison of insurers’ performance was facilitated by media outlets such as *The Economist* and *Which?*, a magazine founded in 1957 by the Consumers’ Association to rationalise consumption not by prescribing consumers what to do, but

by providing information about company performance (Aldridge, 1994). Intermittently, these outlets would compare the performance of different funds on different policies (see figure 4.3). Insurers, in turn, increasingly started using investment yields as a ‘competitive weapon’ as manifested, for instance, in advertising (Scott, 2002, p. 80).

**Table 4—Life assurance comparisons**  
 Amounts paid out on life policies of annual premium £50, taken out by a man aged 29, at normal rates

Company	Amounts payable in 1970—with profits policies												New policies started in 1970	
	Whole life policy started in 1930 death in 1970			Endowment policy started in 1945 maturing in 1970			25-year Endowment policy started in 1955			Non-profit		15-year endowment policy with profits		
	Sum assured	Bonuses	Total	Sum assured	Bonuses	Total	Payable in 1970 on death			Sur-rendered in 1970	Whole life policy	25-year endowment policy	Sum assured	Payable on maturity (£)
							Sum assured	Bonuses	Total					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
£	£	£	£	£	£	£	£	£	£	£	£	£	£	
Atlas	2,079	3,959	6,038	1,136	1,335	2,471	1,177	893	2,070	1,074	4,315	1,792	671	1,167
Australasian Mutual Provident	2,076	2,473	4,549	1,286	741	2,027	1,286	499	1,785	920	3,711*	1,593	781	1,063
Caledonian	2,132	3,224	5,356	1,178	1,250	2,428	1,149	890	2,039	878	4,315	1,792	671	1,167
Clerical Medical and General	2,106	3,694	5,799	1,094	1,426	2,510	1,162	955	2,117	1,076	4,267	1,532	647	1,181
Colonial Mutual	2,260	3,167	5,427	1,255	1,274	2,529	1,203	632	1,836	848	3,678*	1,631	706	1,192
Commercial Union	---	---	---	1,150	1,016	2,166	1,163	662	1,825	947	4,247	1,832	674	1,187
Co-operative	2,113	2,645	4,758	1,224	1,069	2,293	1,178	673	1,851	830	---	---	894	1,038
Crusader	---	---	---	---	---	---	1,112	740	1,852	833	4,474	1,717	670	1,210
Eagle Star	2,960	2,140	4,220	1,225	927	2,152	1,189	609	1,798	871	4,615	1,818	686	1,136
Ecclesiastical	1,136	3,964	6,099	1,265	1,511	2,776	1,220	960	2,200	1,166	4,913	1,538	726	1,198
Equitable	1,852	3,306	5,158	1,250	1,299	2,549	1,205	866	2,071	1,050	4,724	1,976	701	1,310
Equity & Law	2,047	4,251	6,298	1,232	1,318	2,550	1,192	1,037	2,229	1,146	4,672	1,811	665	1,225
Friends Provident	2,083	3,462	5,535	1,182	1,408	2,591	1,182	784	1,966	984	4,132	1,718	699	1,269
Guardian	2,047	4,466	6,512	1,232	1,951	3,183	1,175	933	2,108	970	4,314	1,791	673	1,177
Legal & General	---	---	---	---	---	---	1,173	680	1,853	972	4,544*	1,797	689	1,095
Life Association of Scotland	2,044	1,734	3,778	1,259	798	2,057	1,186	691	1,777	834	4,185	1,792	684	1,152
London & Manchester	2,065	2,870	4,935	1,227	1,236	2,463	1,150	729	1,879	813	3,243	1,811	703	1,040
London Life	2,212	2,865	4,987	1,269	1,067	2,336	1,213	704	1,917	1,056	4,567	1,779	701	1,244
Marine and General	2,047	2,613	4,660	1,217	1,180	2,397	1,184	801	1,986	900	4,210	1,797	695	1,211
Mutual Life & Citizens	2,166	2,530	4,696	1,304	599	1,903	1,304	416	1,720	836	3,776*	1,700	777	1,069
National Mutual	2,089	4,356	6,434	1,208	1,247	2,455	1,176	748	1,924	906	3,448*	1,562	694	1,173
National Mutual of Australasia	2,142	2,676	4,817	1,235	769	1,994	1,317	501	1,818	854	4,201	1,801	773	1,179
National Provident	1,993	3,306	5,299	1,226	1,158	2,384	1,204	750	1,984	861	3,333	1,798	719	n.s.
Norwich Union	1,832	3,511	5,443	1,208	1,406	2,614	1,208	926	2,134	891	4,000	1,724	697	1,323
Peerl	2,040	2,787	4,827	1,238	1,203	2,441	1,180	727	1,907	858	3,448	1,602	688	1,179
Phoenix	2,048	2,430	4,478	1,121	910	2,031	1,147	645	1,792	880	4,392	1,740	646	1,009
Provident Life	2,054	1,987	4,041	1,246	781	2,027	1,185	589	1,734	830	4,166	1,785	694	1,113
Provident Mutual	2,054	3,491	5,545	1,344	1,237	2,581	1,177	741	1,918	759	4,053*	1,699	721	1,142
Prudential	2,181	3,107	5,288	1,228	1,217	2,445	1,172	774	1,946	1,061	4,912*	1,865	693	1,196
Refuge	2,149	2,246	4,395	1,235	859	2,094	1,183	547	1,710	822	---	---	1,067	690
Royal	2,083	2,527	4,610	1,167	966	2,123	1,158	669	1,827	900	4,685	1,841	671	1,120
Royal Exchange	2,040	3,214	5,254	1,174	1,317	2,491	1,174	952	2,126	1,031	4,314	1,791	673	1,177
Royal London Mutual	2,143	3,381	5,524	1,222	1,320	2,542	1,143	819	1,982	711	3,399	1,649	680	1,102
Scottish Amicable	1,833	2,574	4,507	1,176	978	2,154	1,163	629	1,792	968	3,992	1,786	666	1,097
Scottish Equitable	2,000	3,579	5,579	1,200	1,243	2,443	1,158	722	1,878	910	4,318	1,643	667	1,141
Scottish Life	2,109	2,311	4,420	1,235	1,010	2,245	1,167	672	1,829	854	3,810*	1,711	678	1,006
Scottish Mutual	2,062	4,394	6,456	1,218	1,367	2,585	1,188	861	2,039	807	3,840*	1,696	679	1,192
Scottish Provident	2,733	2,788	5,521	1,180	1,423	2,603	1,165	853	2,015	1,120	4,504	1,905	683	1,164
Scottish Widows	2,027	5,195	7,222	1,173	1,760	2,933	1,153	884	2,037	1,132	4,481*	1,855	654	1,134
Standard Life	2,065	5,424	7,489	1,204	1,818	3,022	1,174	911	2,085	963	4,234	1,777	695	1,128
Sun Life	---	---	---	---	---	---	1,153	678	1,829	842	4,103	1,745	693	1,213
United Kingdom Provident	1,990	3,520	5,510	1,223	1,323	2,546	1,159	808	1,967	1,007	4,410*	1,800	686	1,218
Wesleyan & General	2,090	2,117	4,207	1,246	763	2,008	1,187	482	1,679	772	3,974	1,737	699	1,092
Yorkshire General Life	2,037	1,854	3,891	1,184	735	1,919	1,167	589	1,728	854	4,167	1,785	725	1,056
Yorkshire	2,037	2,190	4,227	1,176	869	2,045	1,176	628	1,802	901	4,167	1,786	685	1,096

Policies now being issued normally give unrestricted cover. Nearly all the offices offer better terms to women, usually by fixing premiums as if they were 3 years younger than their actual age. (a) Estimated on the basis of current bonus rates. \*Premiums cease at age 65; †Premiums cease at age 90.

**Figure 4.3** An example of a comparison of the performance of different life companies, published by *The Economist* (Anon., 1970).

The increased emphasis on investment, facilitated by such devices as industry comparisons, the adoption of bonus distribution policies and a series of surges and slumps in stock market prices, contributed to life insurers’ shifting investment practices. Over the course of the twentieth century, for instance, there was a gradual rise of the ‘cult of equity’ – the belief that insurers’ should primarily invest in shares. The cult of equity finds its roots in the interwar period when ‘investment philosophy’ started moving away from conservative fixed-income strategies towards equity

investments (Scott, 2002). Struggling to maintain the real value of surpluses available for distribution in the face of competition from deposit-taking institutions, insurers increasingly perceived investment in stocks as a means to protect the value of their assets against inflation and currency depreciation. The cult of equity gained momentum in the 1950s and 60s. The equity-backing ratio of with-profits funds rose from 20/30% in the late 1950s and early 1960s to more than 50% in 1976 (Dodds, 1979; Turnbull, 2017); anecdotal evidence suggests that in 1981 at least some with-profits funds were fully equity-backed (Redington, 1981; Turnbull, 2017). Consequentially, insurers were among the largest stock owners of UK's capital markets. In the 1950s, they owned no more than 10% of all stocks outstanding; in the 1980s, however, insurers owned around 20%, retaining that level (with a high point in 1997 of 23.6%) until the early 2000s (ONS, 2017).

Another crucial market device is the sales arrangements that insurers have at their disposal. Due to the complex and long-term nature of life insurance products, sales strategies play a pivotal role in competition. Historically, and with a few exceptions, life insurers did not own any distribution channels, but made use of independent sales agents, often working for local bank branches, who would sell policies only of a limited number of companies. In contrast, some of the new entrants, such as Abbey Life and Hambro Life, started selling unit-linked policies through commission-based direct sales forces, a costly but effective means to gain market share. The affiliations of the challenger firms with actors in adjacent fields were also important here. The banks with which these companies were affiliated prohibited their local branch managers from selling policies from other companies, restricting insurers' access to banks and building societies' branch network (Gupta and Westall, 1993). The 1986 Financial Services Act, which introduced 'polarisation', further added to insurers' strain (Black and Nobles, 1998). The Act compelled sales agents either to be tied to specific companies (selling the policies of those companies only) or to be fully independent (offering the whole range of policies available in the market). Its consequence was a significant reduction of independent agents. Insurers were therefore forced to compete over access to 'tied agents', and continued to develop direct sales forces. As a consequence, some

insurers merged with or were acquired by banks (Gupta and Westall, 1993; Carter and Falush, 2009, pp. 68–71).

While the introduction of unit-linked insurance thus contributed to changing insurers' sales apparatus, the introduction of another device – that of 'asset shares' – drew on unit-linked insurance as an exemplar for how bonuses should be distributed. Asset shares, like units, are policy-specific measures of the share of total assets in a with-profits fund obtained by investing (and reinvesting) the premiums of a specific policy, minus the expenses that have been attributed to it. An asset share, in other words, is a 'retrospective' or backwards-looking measure of policyholder benefits that is similar to the benefits of an equivalent unit-linked policy. Asset shares were increasingly used by with-profits funds as a guide to determining appropriate terminal bonus policies since the 1970s (sometime after the terminal bonus mechanisms were introduced to allow for the distribution of 'unrealised capital gains' on equity investments), albeit not by all offices. With-profits policies were traditionally understood to offer more stability than equity-linked investment products; they were subject to a degree of smoothing. Some argued, therefore, that the usefulness of the retrospective method of asset shares to determine terminal bonuses was limited if policyholders expected insurance benefits to be stable from year to year. As some actuaries suspected, however, due to the proliferation of market devices like stock market indexes and benefit comparisons across with-profits funds, 'it is possible that policyholders ... expect rather less smoothing of with-profits payouts than in the past' (Eastwood *et al.*, 1994, p. 501). In such cases, asset shares, being loosely analogous to the unit-linked principle, could be useful in deciding on the level of terminal bonuses, whilst 'smoothing' could be achieved, for instance, by limiting the annual change in terminal bonuses to a fixed percentage level threshold.

The emergence of the asset share device not only provided a resource for with-profits funds to compete with the challenger firms selling unit-linked insurance but also contributed to the emergence of a new type of insurance: unitised with-profits insurance, a hybrid type of insurance that combined elements from conventional and unit-linked insurance. After the 1973-74 stock market slump, unit-

linked actuaries started arguing that prospective policyholders demanded more security than unit-linked insurance had offered.

For a number of years [policyholders'] concern had been to participate in the profits of equity investment, and the concomitant risk was generally ignored. Suddenly the risk was seen as more important than the potential gain, and the demand was for stability and guarantees. (Squires and O'Neill, 1990, p. 281)

As seen in the previous chapter, however, actuaries employed by challenger firms also increasingly agreed that guarantees on unit-linked policies were costly. While unit-linked offices could compete with with-profits offices by providing a different 'type' of insurance, they could not compete by offering with-profits contracts themselves, partly because they did not have the benefit of an estate. The reserves needed to back the guarantees were therefore provided not by past generations of policyholders, nor by shareholders, but rather by future policyholders. In case the guarantees would bite, prospective terminal bonuses of continuing policyholders could be reduced.<sup>14</sup> While unitised with-profits provided a means for the security of with-profits insurance to be combined with unit-linked insurance's emphasis on investment, it also reintroduced some of the 'conflicts' that Weinberg had argued unit-linked insurance to circumvent (see chapter 3). The introduction of asset share methodology was thus an important catalyst of hybridisation of unit-linked and conventional life insurance.

The introduction of asset share methodology coincided with another important 'device' that had important implications for the degree of authority imputed on the actuarial profession by the state: the regulatory requirement for insurers to ensure that policyholders' 'reasonable expectations' are met. The term 'policyholder reasonable expectations' was part of the 1973 Insurance Companies Amendment Act, which was intended to strengthen insurance supervision after several (general) insurers had failed in the 1960s and early 1970s (Daykin, 1992). The Act endowed the Secretary of State with the discretionary power to intervene in the affairs of a

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<sup>14</sup> To reduce risk, moreover, unitised with-profits funds typically invested the underlying units in 'managed units', the primary aim of which was to reduce the likelihood of the guarantees to 'bite' and only secondarily to optimise 'expected returns' (Squires & O'Neill, 1990).

company if it threatened to fail on its contractual obligations, ‘or, in the case of long term business, to fulfil the reasonable expectations of policyholders or potential policyholders’ (*Insurance Companies Amendment Act 1973*). It was, in other words, a device intended to undercut opportunistic and perhaps fraudulent behaviour in the search for market share.

The Act, however, left unspecified what constituted policyholders’ expectations as reasonable and the precise meaning of the phrase became subject to significant debate within the actuarial profession. In his 1986 Presidential Address, the then President of the Institute Marshall Field decided to take this ‘notorious phrase’ as a central topic and noted that there were ‘perhaps two separate meanings of the phrase’ (Field, 1987, p. 2). The first one, he noted, was statutory and referred to the level of benefits to which policyholders were reasonably entitled. Although this meaning was ‘for the lawyers to determine’, Field was unconvinced that it was possible to quantify policyholders’ reasonable expectations satisfactorily in ‘legal terms’. The second meaning of the phrase was actuarial, Field argued, and referred to policyholders’ expectations of future bonus declarations. In contrast to the regulatory meaning of the phrase, the actuarial meaning took such expectations as one of the ‘objectives’ of valuation rather than being a principle of valuation in itself. As such, Field argued, there were circumstances in which ‘policyholders’ expectations as regards the level of bonus declarations ought *not* to be realised’ (Field, 1987, p. 2). The ‘justifiable expectations of a policyholder’, Field argued, should therefore not refer to any quantifiable amount, but rather to the fact that policyholders should be able to trust the actuary as custodian of a company’s surplus.

Not only the question of the methods through which discretionary benefits in with-profits business were to be determined was at stake, but also the extent of actuaries’ professional freedom in applying those methods. In addition to increasing regulatory powers, the 1973 Act created the function of the Appointed Actuary, a designated actuary responsible for continuously monitoring that statutory obligations were met (Daykin, 1999). To outline what this meant, the actuarial profession published its first Guidance Note, outlining some standards to which the appointed actuary should conform in so doing. Although the function of the appointed actuary

strengthened the position of actuaries within firms – the actuarial jurisdiction was now enshrined in legislation – the issuance of such practical standards threatened to impose constraints on the ‘freedom’ that actuaries had traditionally enjoyed. To dull the effect of these constraints, the standards were phrased in rather an equivocal language, a point that was emphasised in various sessional meetings. At an Institute discussion of the Guidance Note, for instance, the actuary Gerald Barrow – who had prepared an introductory note – said that: ‘Each of the 30 separate clauses could give rise to a differing emphasis of opinion even among those who are in general agreement with the guide’ (Barrow, 1976, p. 138). Both the legal meaning of ‘policyholder reasonable expectations’ and the interpretation of the standards to which Appointed Actuaries should conform in safeguarding such expectations were thus not generally agreed upon.

## Restructuring Mutuals: The Emergence of a New Market Order

By the early 1990s, the capital base of conventional insurance arrangements had significantly eroded, which was due to a combination of management actions taken as a function of competitive pressures and increased values of insurance liabilities due to declining interest rates. Competitive pressures pushed insurers to pay out relatively high benefits, sustaining, for instance, high reversionary bonus rates and turning out substantial terminal bonuses, while, at the same time, business volumes expanded significantly in the 1980s, causing significant new business strain for conventional insurers (Dumbreck and Sanders, 1993). Insurers’ expenses rose too. In competing for new business, companies often resorted to expensive distribution channels, increasing the overall cost of insurance provision. After the implementation of polarisation, moreover, these distribution channels had become harder to access for smaller funds, which led to increasing concentration of new business (Needleman and Westall, 1991).

Regulatory changes further contributed to the worsening of insurers’ capital position and strengthened the focus on capital management. Since the mid-1980s, regulators required some insurers to perform a ‘resilience test’, in which they had to



assess the impact of a 25% stock market decline and a 3% rise or fall of interest rates, and, subsequently, had to hold capital reserves against that (Fine *et al.*, 1988). Together with falling interest and mortality rates, this further diminished insurers' 'free assets'. The deteriorating capital position of conventional insurers put pressure on insurers' management. 'A relatively modest fall in share prices in the summer of 1992', the actuaries noted, 'left a number of companies with solvency margins close to the minimum level, and put them under pressure to rearrange their investment portfolios in order to preserve statutory solvency' (Dumbreck and Sanders, 1993, p. 30).

To resolve the capital strain, Dumbreck and Sanders continued, companies pursued several strategies. A first option was, of course, to cut back some of the bonuses. Some of the companies were paying policyholders in amounts exceeding asset shares and by reducing payments to slightly below asset shares, companies could replenish reserves. This, of course, was a precarious measure, because the reduced bonuses could repel potential customers as well as already existing ones. Nevertheless, Dumbreck and Sanders noted, some companies pursued this strategy and 'found the market surprisingly receptive to their prudence in doing so' (Dumbreck and Sanders, 1993, p. 30). A second option was to increase the proportion of unit-linked or unitised with-profits business in their portfolio, which could reduce the problem of bonuses in excess of asset shares and new business strain – a strategy, as the evidence suggests, few companies pursued before 1995, but was widely embraced since then (O'Brien, 2009).

Many mutual companies pursued a third option: demutualisation. Mutual companies were owned by their with-profits policyholders, who by accepting a degree of uncertainty in future benefits provided the company with reserves. The reserves further included the 'estate', or the 'free assets' that were 'inherited' from previous generations of policyholders. When both pools of reserves were depleted due to, for instance, adverse market conditions, the company could get in significant financial trouble and might eventually become 'technically insolvent', a situation that could only be resolved through premium income in excess of claims and expenses outgo or an increase in the market value of assets. In a competitive environment,

however, free capital was needed to allow a company to pursue different strategies (Needleman and Westall, 1991). Demutualisation provided an effective means to alleviate capital strains on stressed mutual funds. When a company would demutualise, it would receive an additional capital injection from new shareholders who could, moreover, provide future capital injections if necessary.

Many of the demutualising funds were distressed and in need of new capital or access to distribution channels. Some mutual funds, however, demutualised from a 'position of strength' (Eastwood interview). Opinions about the desirability of highly capitalised mutual offices to demutualise diverged greatly. While some actuaries considered demutualisation to be a 'fad', a strategy that some companies pursued simply 'because everybody was demutualising at the time' (Forfar interview), others considered it a 'one-off opportunity' for policyholders (Eastwood interview). A 'disciplined application of a properly-tested' asset share and bonus methodology, Eastwood argued, reduces the level of capital required to back with-profits liabilities. In that case, having a large estate provided little additional benefits for existing and future customers, whose ownership of the estate, moreover, would only be temporary. In a demutualisation transaction, part of a company's 'orphan estate', as it was sometimes referred to, could be distributed across policyholders, providing them with potential one-off windfall payments, particularly when the orphan estates were large.

Demutualising appeared very attractive indeed to policyholders of strong mutual companies with large estates. The perceived advantages (they were promised large windfall payments) far outweighed costs (loss of ownership and the estate), which was partly due to the fact that the advantages of having an estate were diffuse (they were spread out over generations), while the benefits of distributing it were concentrated, directly benefitting the current generation of policyholders. The demutualisation of Scottish Provident, for instance, entailed an average £4,000 windfall payment to policyholders (Bachelor, 2001). Similarly, Scottish Widows made one-off payments to its policyholders of £5,500 on average, with the maximum windfall payment amounting to £116,000 (Jones, 1999). It is little surprise, therefore, that such demutualisation transactions were strongly favoured by policyholders. In

the case of Scottish Provident, for instance, 97% of more than 200,000 voting policyholders voted in favour of the deal.

The demutualisation wave brought to the fore some of the social tensions that were built into conventional with-profits insurance. In an early discussion of the subject at the Institute, it was noted that several questions needed to be addressed in designing a demutualisation transaction (Field *et al.*, 1991). First, what exactly constituted policyholder reasonable expectations? As noted above, the interpretation of the clause had remained rather vague since its implementation. The context of a demutualisation transaction, however, required a practical interpretation, because demutualising insurers had to show how they intended to make sure the interests of policyholders were protected before getting regulatory approval to do so. Second, how should compensation for demutualisation be allocated across different policyholders? Although it was clear that such an allocation mechanism should roughly reflect the contribution that each policyholder had made to the existing surpluses, for several technical reasons it was not clear how exactly this should be done. Third, but not least important, what should be the size of compensation? In a demutualisation transaction, policyholders forfeited their property rights as well as the estate and a share of future profits. How much compensation was appropriate, however, was difficult to say. In the early 1990s, there were several cases in which the orphaned assets of proprietary with-profits funds were at stake in a struggle between shareholders and policyholders (Penrose, 2004, p. 428), a tension in conventional with-profits insurance that was now introduced in some of the formerly mutual companies too.

In addressing these questions, the demutualisation issue established a link between ‘policyholder reasonable expectations’ (PRE) and asset shares, two devices that had theretofore remained separate. In order to protect policyholders’ interests, there was a perceived need to define more clearly what constituted policyholders’ reasonable expectations. The Institute subsequently set up a working party to this end, chaired by the actuary Bernard Brindley, which concluded that at the very minimum PRE consisted of the expectation that guaranteed benefits (including any reversionary bonuses already rewarded) were met in full and that the company would

be managed ‘ethically and competently’ (Penrose, 2004, p. 436). Many recognised, however, that PRE should include something more than just guaranteed benefits and competent management. After all, with-profits policyholders expected to be compensated (through bonuses) for paying premiums in excess of equivalent non-profit premiums and accepting a degree of uncertainty. In seeking to define how much policyholders could reasonably expect this compensation to be, it noted that ‘in the normal day-to-day actuarial management of a life policy, PRE is synonymous with equity and the almost universal method for measuring it is asset share calculation’, but added that ‘it is, naturally, widely accepted that there are differing ways of calculating asset shares’ (Brindley 1990 as quoted in Penrose, 2004, p. 437). By establishing equivalence between the two terms, the equivocal meaning of PRE was thus replaced with the almost equally equivocal meaning of asset shares. The inability to determine the meaning of PRE points to a core feature of conventional with-profits arrangements: namely, the role of actuarial discretion as a mechanism for dealing with uncertainty – a feature that sat uncomfortably with the logic of private property and ‘equity’. Nevertheless, with the introduction of asset shares, with-profits policyholders were increasingly seen as a type of shareholder with equity stakes.

The restructuring of the life insurance industry that took off in the 1990s had some important implications for the industry. By the end of the noughties, there were almost no mutual life offices left. Although mutual offices were not insulated from the social tensions embedded in conventional insurance, the absence of shareholders meant there was at least one less tension. Actuaries with experience of working at mutual offices believed – in varying degrees – that ‘being able to look after the best interests of policyholders with no concern for shareholders leads to better investment performance, actuarial management and general strategy’ (Eastwood *et al.*, 1991, p. 173). After demutualisation, many of the offices were acquired by non-insurance companies looking to enter the insurance market, some of whom were banks. In such cases, a demutualisation transaction could have a significant impact on insurers’ investment practices. When Scottish Widows was acquired by Lloyd’s TSB, for instance, the latter required the former to ‘hedge’ its exposure to fluctuations in interest rates (Dumbreck interview). Moreover, the liquidation of insurers’ estates,

which were typically invested in equity shares, contributed to an overall decline in insurers' equity holdings.

In sum, the wave of demutualisations brought to the fore some of the social conflicts that were woven into the structure of conventional with-profits insurance and, in so doing, constituted pressure on the actuarial profession to formalise the interpretation of PRE. Reluctant to formalise the meaning of PRE, however, the almost equally equivocal concept of 'asset shares' was taken as a placeholder. Although many companies applied 'asset share' methodology in practice, thus providing 'instances' from which the meaning of the term could be inferred, applications of the concept diverged greatly. Thus, while some degree of formalisation was achieved, it remained possible to interpret the concept in multiple, often contradictory but equally valid ways. Nevertheless, efforts to interpret PRE in the context of demutualisation had led to emphasise the similarities between with-profits policyholders and shareholders and the efficiency of companies' capital structure.

## 'With Profits, Without Mystery'

When investment conditions further deteriorated in the early 2000s, many UK life insurers experienced severe stresses. After an initial drop in the early 1980s, interest rates continued to decline throughout the 1990s. Subsequently, with the bursting of the Dotcom bubble, stock markets slumped in the period 2000-2003. Although US stock markets were most severely struck, the FTSE-100 index based on the top 100 companies listed on the London Stock Exchange nearly halved in this period. Many insurers (though not all) got into significant financial trouble, and some of them, like Pearl Assurance, Royal Life and Sun Alliance, closed for new business. Most troubled of all was Equitable Life. After a ruling by the House of Lords (discussed in more detail below) the company had to put itself up for sale. When it failed to find a buyer, the company closed its doors to new entrants. Soon after, it became known that the company's shortfalls were much more substantial than had initially been assumed and the affair turned into a major scandal. The government eventually put

£1.5bn into a compensation scheme for Equitable's policyholders and estimated total policyholder losses at £4.1bn (HM Treasury, 2016).

In many ways, the story of Equitable Life is exemplary of the above-described developments, although – as some of my interviews pointed out – some of its practices were regarded as rather unconventional and idiosyncratic. The story is entangled with that of pension provisioning for university staff. In the 1960s, the Equitable Life ran a rather small with-profits life insurance fund, highly dependent on pensions business from the Federated Superannuation Scheme for Universities, which amounted to more than half of the company's business (Penrose, 2004, p. 69). When the Federated Superannuation Scheme for Universities had to restructure due to tax reforms and Equitable, as a consequence, lost a large chunk of its business, the company changed tack. From the 1960s onwards, 'Equitable embarked on a programme of branch expansion in the middle of the 1960s, revised its marketing policy and adopted a more aggressive approach to sales' (Penrose, 2004, p. 69). In the second half of the twentieth century, therefore, the company grew substantially. In 1960, its total assets amounted to £39mln; in subsequent decades this figure increased to £113mln in 1970, £534mln in 1980, £5,786mln in 1990 and, eventually £33,553mln in 2000 (Penrose, 2004, p. 70).

The company's expansion, fuelled in part by the sustenance of high bonus rates, contributed to the depletion of its surplus. In response, Equitable's actuaries gradually altered the company's bonus system to a system they would later refer to as the 'managed fund' approach – an approach that was akin to unitised with-profits insurance as described above. The Penrose report, which concluded a lengthy investigation in Equitable's downfall – argued that Equitable's actuaries had developed their approach rather haphazardly. To sustain high bonus rates, the Equitable Life had drained its estate, first in the early 1970s, and, after having rebuilt it temporarily, again throughout the 1980s (Penrose, 2004, p. 119). It then adopted a 'full distribution' policy in the 1980s. In contrast to market convention, Equitable's policyholders would receive benefits that would 'reflect the value of the assets in the fund attributable to [each policyholder's] policy, i.e. that policyholder's asset share', albeit without 'the precision that applies with linked business' (Ranson and Headdon,

1989) – the asset shares were subject to smoothing. Policyholders, in other words, would receive their asset share plus or minus an adjustment for current market conditions. As a result, the company’s surpluses continued to shrink, and, as noted in the Penrose report, to such an extent that the company ‘entered the 1990s with a negative estate accordingly’ (Penrose, 2004, p. 117).

Competing aggressively, the company thus developed a new approach to with-profits insurance which allowed it to sustain (temporarily) high bonus rates and which could leave the company (again temporarily) with a deficit. In 1989 and 1990, Equitable’s actuaries Roy Ranson and Chris Headdon (Ranson and Headdon, 1989, 1990) took the unusual step to present a paper describing their ‘managed fund’ approach at both the Institute and Faculty of Actuaries, entitled ‘With Profits, Without Mystery’ (actuaries typically refrain from discussing the specific practices of their companies and rather focus on industry practice at large). ‘Within our office’, Ranson and Headdon explained the motivation of their paper, ‘we had begun to feel a growing frustration with the fairly prevalent obfuscation within the industry regarding with-profits business compared with our tendency to view it in a simple straightforward way’ (Ranson and Headdon, 1989).

The response to Equitable’s managed fund approach was strongly divided. Some praised Equitable’s approach for its simplicity and flexibility, but many were also critical, particularly for the fact that it seemed to endow the company with even more discretion than they already had. Marshall Field, who, as discussed above, had expressed concerns about the extent of freedom offered to offices in running with-profits funds in his presidential address only two years before, wondered ‘what controls are there on the discretion that I was so concerned about?’ (Ranson and Headdon, 1989). Increased transparency of bonus distribution could lead to enhanced commercial pressure to sustain high bonus rates. Some also questioned the desirability of running a fund without an estate, particularly in the case of a mutual office (such as Equitable) which did not have access to shareholder capital. Hugh Scurfield, for instance, argued that an estate could serve as a capital buffer against investment risk, allowing an office to invest in riskier but also more profitable assets. Similarly, at the Edinburgh discussion of the paper, Adrian Eastwood argued that an

estate was indeed necessary to support the ‘mismatch’ risk of the guarantees contained in the policies.

Still others argued that the concepts used to describe the approach remained unclear. For example, while Ranson and Headdon noted that with-profits policyholders ‘expect a return broadly commensurate with a unit-linked approach’, they also seemed to imply – unlike a unit-linked approach – a great degree of smoothing. What, some wondered, did an asset share precisely consist of in this case? ‘Is the asset share regarded as including the smoothing element, or is it a figure which then has the smoothing process applied to it?’ (Jenkins in Ranson and Headdon, 1989, p. 327). Thus, even though some considered the managed fund approach to offer a simpler and more flexible alternative to conventional business, and, indeed, they suspected that some other offices were running on a similar approach, it was also recognised that it contained some important challenges, not least of which was the tension between adopting an ‘equity’ approach to asset shares and the smoothing logic of conventional insurance, which required at least some degree of discretion.

## Finitism, Expectations and the Guaranteed Annuity Options Crisis

Although Equitable’s approach, which was itself born out of an attempt to reinvigorate a declining company by aggressively competing for market share, contributed to the overall deterioration of the company’s financial position, the most severe blow would come from a court ruling by the House of Lords. In the court case, it was the meaning of concepts such as ‘actuarial discretion’, ‘policyholder reasonable expectations’ and ‘asset shares’, which were at stake. As suggested by meaning finitism (discussed in chapter 2), the meaning of terms such as these is not intrinsic but generated through specific applications. The court case, as I argue in this section, sanctioned a particular application of policyholder reasonable expectations that was at odds with how actuaries had previously understood it, which ultimately points to a deeper tension in with-profits insurance as it existed in the late 1990s: the tensions between the equity view of policyholder reasonable expectations and the



twin-mechanism for dealing with uncertainty, comprised of actuarial prudence and discretion.

The court case revolved around the Guaranteed Annuity Options (GAOs) that Equitable Life and several other companies sold as part of their pension policies. A GAO gives a policyholder the right (but not the obligation) to convert a lump sum amount at the end of a savings contract into an annuity (a regular stream of payments until death) at a predetermined rate. A guaranteed annuity rate of 10%, for instance, would guarantee that a policyholder, given a certain age, would receive £100 per annum until death for every £1,000 cash at maturity of the savings policy. The value of a GAO thus depends on interest rates as well as mortality. If interest rates or mortality declined, the value of the annuity would increase. The GAOs thus provided policyholders with some security for a minimum retirement income. GAO policyholders need not buy the annuity at the guaranteed rate; they may in time also buy an annuity at the current market rate. At the point at which the guarantees were sold, these market rates were typically much more attractive than the ones that were guaranteed.

Equitable Life, which sought to compete aggressively in the market for pension business, had sold relatively large quantities of GAO policies from 1957 (when it started selling individual pension plans) to 1988 (when personal pensions were introduced). While at the time the GAOs were sold, current annuity rates were typically much more attractive than guaranteed rates, this gradually started to change in the 1990s. Most problematic were the contracts being sold from 1975 onwards when Equitable increased its interest rate assumptions in a period of high inflation and concomitantly high interest rates (Corley, 2001; Penrose, 2004). In subsequent years, as interest rates declined throughout the 1980s and 90s and life expectancy continued to increase above expectation, the GAOs sold by Equitable increasingly started to bite. Already in 1982, market interest rates briefly dipped below those assumed in the GAO policies. In the early 1990s, guaranteed annuity rates briefly exceeded those offered in the open market (the GAOs started to 'bite'), and, finally, from 1997 onwards they continued doing so increasingly (O'Brien, 2006).

When the GAOs started biting, there was a large degree of uncertainty about how valuable they were. First, the optionality of a GAO meant that it was difficult to assign a value to it considering that the variables affecting it were random. Although actuaries agreed that even non-biting GAOs still carried a risk – a risk for which policyholders should be charged – it was unclear how large the risk and the charges for it should be. This was partly because actuaries typically evaluated the value of GAOs deterministically – that is, using ‘prudent’, point-based estimates for interest rates and mortality; it was difficult to say how prudent such estimates were. Another complicating factor was the infrequency of knowledge produced about longevity improvements. As Andrew Chamberlain, who worked as an actuary at the Government Actuary’s Department at the time, later wrote to the Penrose Inquiry: ‘Companies can see changes in interest rates, but lighter mortality rates are not seen on the same daily basis’ (Chamberlain in Penrose, 2004, p. 607). In addition, Chamberlain continued, it was difficult to assess to what extent seeming improvements in longevity were not actually ‘statistical noise’, and to what extent the ‘rate in longevity improvements’ was picking up. Companies thus had limited means to assess how the value of GAOs would change as circumstances changed.

The annuity guarantees issue brought to the fore some of the tensions that might exist among policyholders in a with-profits fund. As Nick Dumbreck recalls, the issue of annuity guarantees came up in the demutualization of Provident Mutual, a company with ‘some quite onerous guarantees’ on its books (Dumbreck interview). Dumbreck was Chair of the Life Research Committee of the UK actuarial profession at the time and ‘was instrumental in setting up’ a joint Faculty and Institute working party to compare insurers’ reserving practices. After having set out a survey, the working party found that of the 66 responding companies (representing 90% of the total market), 41 had sold annuity guarantees. The total value of liabilities of the 41 companies, according to the survey, was £304 billion, of which £35 billion contained annuity guarantees (Bolton *et al.*, 1997). Some companies sought to establish explicit reserves for the guarantees by adjusting bonuses on with-profits policies. The question remained, however, who should be charged for the cost of guarantees? Should the costs be spread equally across all policies or only across those policy types and maturities that would directly benefit from having such guarantees? In the

former case, policyholders without annuity guarantees would be affected by policies that were not their own. The latter approach, however, which was also referred to as a ‘differential terminal bonus policy’, seemed to defeat the purpose of a guarantee. After all, if exercising the guarantee meant that the contract’s lump sum benefits were to be reduced, then what was the point of having the guarantee in the first place?

By the late 1990s, Equitable Life’s estate had already eroded, but it also did not want to charge its non-GAO policyholders for policies that were not their own. It decided, therefore, to operate a differential terminal bonus policy, a policy that Equitable’s actuaries had first cooked up in the early 1980s when interest rates dropped below those implied by the GAOs (Penrose, 2004). The policy was defined as follows (Penrose, 2004, p. 6):

The income available to the policyholders is the higher of:

- (i) Fund (including final bonus) x current annuity rates;
- (ii) Fund (excluding final bonus) x GAR [Guaranteed Annuity Rate].

However, according to the Penrose inquiry, Equitable Life had poorly communicated its intention to use a differential terminal bonus policy to its policyholders, and, in 1998, it started receiving complaints from its policyholders, who, to their dismay, discovered that the guaranteed annuity rate only applied to their guaranteed benefits. The company’s management, confident it had a strong case, sought to settle the issue by bringing it to court. The court proceedings initially looked favourable but took an unexpected turn. While the high court ruled in favour of Equitable, its decision was overturned by the Court of Appeal in a 2-1 vote.

The case was eventually put before the House of Lords, which ultimately ruled Equitable’s differential terminal bonus policy illegal in a 5-0 vote. Although the Lords recognised that ‘[b]onuses are determined by directors in the exercise of a discretion conferred upon them’, they argued that adjustments to the company’s bonus policy to override the effect of having a GAO undermined policyholder reasonable expectations.

[F]inal bonuses are not bounty. They are a significant part of the consideration for the premiums paid. And the directors' discretions as to the amount and distribution of bonuses are conferred for the benefit of policyholders. In this context the self-evident commercial object of the inclusion of guaranteed rates in the policy is to protect the policyholder against a fall in market annuity rates by ensuring that if the fall occurs he will be better off than he would have been with market rates. The choice is given to the GAR policyholder and not to the Society. It cannot be seriously doubted that the provision for guaranteed annuity rates was a good selling point in the marketing by the Society of the GAR policies. It is also obvious that it would have been a significant attraction for purchasers of GAR policies. The Society points out that no special charge was made for the inclusion in the policy of GAR provisions. So be it. This factor does not alter the reasonable expectations of the parties. (House of Lords, 2000)

As discussed above, Equitable's bonus policy explicitly aimed roughly to equalise policyholders' benefits with their asset shares. The House of Lords ruled that such expectations should not be altered depending on whether the policyholder chooses to exercise a GAO or not.

Although it is not within the purview of this chapter to explain what factors contributed to the decision falling one way rather than another (that would require a whole other chapter), it is important to note that the degree in which Equitable's practices conformed with legal terms such as 'policyholder reasonable expectations' could not objectively be established in advance of the court rulings. The meaning of such terms as 'policyholder reasonable expectations' and 'asset shares' was open-ended, and the interpretation of the Lords conflicted with the notion that it was up to actuaries to determine what a fair bonus system consisted of. Indeed, many actuaries perceived (and continue to perceive) the decision as a faulty one, even if they recognise that Equitable had made some mistakes. An actuary who worked at the Government Actuary's Department at the time, for instance, noted that: 'The biggest error was a legal error. They [Equitable] worded their policies badly. That and the fact that the House of Lords judgment was actually based upon finding there was an implied term in the contract, which would never have been agreed at the time. The judges didn't understand the full implications, and they created a solution that actually was not sensible' (Chamberlain interview).

The court ruling would have important consequences for the market field and the distribution of epistemic authority in particular. Investigations of Equitable's collapse were critical of the way in which the actuarial profession had exercised its epistemic authority and the concomitant responsibilities. The Penrose Inquiry, for instance, argued amongst other things that actuaries had shown 'reluctance to indulge in mutual criticism' (Penrose, 2004, p. 121), and prompted further investigation into the way in which the profession operated. The subsequent 'Morris Review of the Actuarial Profession', described the actuarial profession as 'a profession that has been too introspective, not forward-looking enough and slow to modernise' (Morris, 2005, p. 4). With the specialist role of the Appointed Actuary, the profession had acquired a special role in the governance of insurers' financial position, but the methods which it applied in carrying out such responsibilities, the Review concluded, were outdated. Collins, Dewing and Russell (2009) described actuaries for these reasons as 'fallen heroes', who had failed in their duty to protect the interests of both individual policyholders and the company. The weakened standing of the actuarial profession was reflected in changes, for instance, in the supervision of the industry. While actuaries employed by the Government Actuary's Department had previously played an important role in supervision, interview data indicates that many of them were given a position with fewer responsibilities after incorporation of insurance supervision into the Financial Services Authority (interview 29; see also: Collins et al., 2009). The collapse of the Equitable, in other words, had led or at least contributed to the decline of the profession's epistemic authority, causing professionals with no actuarial background to take up a more proactive stance in epistemic matters.

## Conclusion

The crucial point of this chapter is that the challenge to conventional insurance arrangements by unit-linked insurance had some important implications for the social order in the life insurance field. As the newly emerging unit-linked companies challenged the dominant position of traditional insurance companies, incumbent insurers increasingly started using unit-linked insurance as an exemplar for the distribution of bonuses in with-profits arrangements. There was a convergence

between unit-linked insurance and conventional insurance. With-profits policyholders were gradually regarded as having an 'equity stake' in the company, similar to that of shareholders, which was reflected in their asset share. The introduction of asset share methodology in some insurance companies thus reduced the discretionary space afforded to actuaries and their companies to adjust benefits according to financial circumstances, which impaired the traditional mechanism for dealing with uncertainty at a time when financial market volatility started to surge. At the same time, however, at least some of the insurers continued to rely on bonus policy as a marketing device. The downfall of Equitable Life in many ways epitomised these developments, even if its practices were not entirely reflective of industry practice more general, and contributed significantly to the decline of the epistemic authority of the actuarial profession.







## Chapter 5

### ‘Taking Account of What the Market Has to Say’

Sometime in 2003, Barrie & Hibbert, a small company based in Edinburgh, received a phone call from an insurance company asking for an ‘economic scenario generator’. Although John Hibbert, who picked up the phone, recalls he ‘had to ask them what they meant’, it was essentially what the company had already been doing since the late 1990s; they simply had ‘never used that terminology before’ (Hibbert interview). After the first company had called, the ‘phone rang again and somebody wanted the same thing, and then the phone rang [again]’ (Hibbert interview). In subsequent years, however, economic scenario generators would become a pivotal piece of technology in the knowledge machinery underpinning the UK’s life insurance market. Barrie & Hibbert, whose scenario generator became widely used, grew to become one of the main (if not *the* main) model providers to the industry.

Barrie & Hibbert started as a relative outsider to the market for actuarial advice. Both its founders were former investment bankers who, for personal reasons, returned from London to Edinburgh. Unable to find a job as ‘quantitative analysts’ in Edinburgh’s financial sector (because there were none), they decided ‘to try and create an advisory research business’ (Hibbert interview). Founded in 1995, Barrie & Hibbert’s helped asset managers manage market risk and understand structured financial products. The company also did some ‘asset-liability management’, the analysis of a company’s investment strategy in relation to its liabilities. When in the early 2000s the UK’s Financial Services Authority required insurers to measure their liabilities using techniques similar to those used in the derivatives departments of investment banks, few insurers had access to relevant expertise. Barrie & Hibbert filled a ‘structural hole’ (Burt, 1992). Their expertise in ‘state of the art’ financial modelling techniques and the work they had done on asset-liability management formed the basis for their economic scenario generator – a piece of software that

allowed insurers to do the required calculations. Barrie & Hibbert soon became the industry's main supplier of economic scenario generators.

Similar to chapter 3, this chapter revolves around the emergence of a new type of modelling practice: the 'market-consistent' modelling of insurance liabilities. Market-consistent modelling – a type of modelling that requires the use of economic scenario generators such as those produced by Barrie & Hibbert – draws from an intellectual tradition quite distinct from actuarial science: that of modern financial economics. In this chapter, I examine how and why the core models of modern finance theory were used as exemplars for the modelling of insurance liabilities. The chapter proceeds as follows: in the next section, I describe traditional valuation practice and the changing institutional environment in which they were deployed. I then describe the emergence of modern finance theory and its influence on financial market practice, before examining how no-arbitrage modelling came to play a role in the epistemic field of actuarial science. In the fourth section, I describe how no-arbitrage models served as exemplars for the market-consistent modelling of insurance liabilities. Finally, I examine how we may understand the emergence of market-consistent modelling as a paradigm shift in the epistemic field of actuarial science.

## From 'Freedom with Publicity' to Statutory Regulation

The UK's regime of 'freedom with publicity' had been in place since 1870. Since then, actuaries were required to perform periodical valuations of insurance liabilities but were free to choose the appropriate methods for doing so, on the condition that they published an actuarial statement describing the methods and assumptions they had used. In the wake of Equitable Life's downfall (discussed in chapter 4), however, this regime came to an end. In this section, I first describe the method that actuaries traditionally used for valuation purposes (and was considered to have failed in the case of Equitable), before describing the regulatory response to the crisis in the insurance industry.

### *The net premium valuation method*

Crucial for the traditional actuarial approach to valuation was the ‘net premium’ valuation method, which is similar, but slightly more complicated than the related ‘gross premium’ method (Turnbull, 2017). A gross premium valuation involves the calculation of the ‘net present value’ of all future income (premiums) and outgoings (expenses, claims), the value of the liability simply being the difference between them. Because premium rates are typically set such that the company expects to make a profit, the net present value of premiums will exceed that of expenses and claims; in a gross premium valuation, then, liability values tend to be negative at their inception. This caused practical problems. Many actuaries considered it ‘inappropriate to immediately recognise the profit that was expected to be generated over the lifetime of the policy’ (Turnbull, 2017, p. 124). After all, profits were only gradually to be distributed to a company’s with-profits policyholders through bonus distributions and, if it was a proprietary company, to its shareholders.

The net premium valuation method, in contrast, was designed to allow for the gradual release of profit. It did so by reducing the present value of premium income so that the net liability value (present value of claims and expenses minus the present value of net premiums) would be zero. The net premium valuation thus implicitly accounts for future bonuses by deducing ‘profit loadings’ from future premium income. These profit loadings then conveniently gave an indication of how large bonuses should be. Although many actuaries agreed that the method had several important weaknesses, net premium valuations remained a core part of insurers’ valuation machinery into the twenty-first century.

This approach was well suited for some purposes but not others. In his famous paper on the principles of life office valuation, Prudential’s chief actuary Frank Redington (1952), for instance, pointed to an important trade-off to be made when deciding on a valuation method:

A valuation has two main purposes, and the fundamental difficulty is that these two purposes are in conflict. The first and primary purpose is to ensure that the office is solvent. The second is to

allow the surplus to emerge in an equitable way suited to the bonus system. The solvency criterion leads to a changing valuation basis, influenced solely by prospective considerations... On the other hand, the pursuit of equity of emergence of surplus tends to lead to stable valuation bases, influenced mainly by retrospective considerations and possibly differentiated according to the terms at issue. We are thus faced at the beginning with that most fruitful source of controversy, the attempt to reply to two different questions in a single answer. (Redington, 1952, p. 298)

The net premium valuation method was designed for bonus purposes and was therefore less suitable for assessing insurers' solvency. Particularly problematic was the fluctuation of interest rates, which, according to Redington, had given rise to an 'expanding funnel of doubt' already in the first half of the twentieth century (Redington, 1952, p. 287). 'A net premium valuation', he continued to explain, 'is only partially sensitive to a change in the rate of interest because the change in the rate is accompanied by a change in the net premiums – a technical idiosyncrasy which has no counterpart in the facts' (Redington, 1952, p. 307). With net premium valuations, it was difficult to see the impact of changing economic conditions on insurers' balance sheets – a feature that became increasingly important with the surging financial market volatility in the 1970s and 80s.<sup>15</sup>

From the 1980s onwards, however, insurers increasingly started using asset share methodology as an alternative approach to bonuses (see chapter 4). One of my interviewees who started working as a junior actuary at a large office in the 1980s (and would later become its chief actuary), remembers that he found it difficult to understand the rationale of the net premium valuation method.

[Q]uite frankly, I found the net premium valuation sort of difficult to understand ... [I]t's trying to allow for profit emergence in a way that suits bonuses. And so you sort of shrug your shoulders and say, well, okay. But, you know, not long after I got there ... asset shares were being used to decide what bonuses you wanted to pay, and then the net premium valuation was just used to produce the answer and the surplus you needed to pay those bonuses. So, you

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<sup>15</sup> The net premium valuation method, moreover, was often used in combination with a set of assumptions known as the 'premium basis', or, in other words, the set of assumptions that were made at the time the contract was written. Even though these assumptions were typically 'prudent', in periods of great economic change, the assumptions made in the premium basis may come to diverge substantially from current market conditions.

know, I'm sure in the 1950s and 60s it was important that the net premium valuation produced the surplus it did and then that was used to pay a bonus. Whereas by the time I got there it ran the other way. You use the asset shares to decide what bonuses you want and then adjusted the net premium valuation to give you the right answer. (Belsham interview)

Although the emergence of asset shares reduced the significance of the net premium valuation method for insurers' bonus policies, many actuaries continued to use it well into the noughties to value insurers' liabilities – a task for which some argued the net premium valuation method was not very well suited.

### *Towards a 'realistic' statutory regime*

Although most regulatory changes took place in the wake of the crisis described in the previous chapter, the supervision of insurance companies had gradually become more stringent already in prior decades. Since the 1870 Insurance Companies Amendment Act, responsibility for insurance supervision lay with the Board of Trade, which, in lieu of in-house actuarial expertise, started seeking advice, first, from actuaries in government service, and from the 1920s onwards from the government's internal actuarial consultancy, the Government Actuary's Department (or the GAD), to scrutinise companies' regulatory returns in the early twentieth century. The GAD quickly became the *de facto* supervisor. For most of the twentieth century, however, the resources dedicated to the supervision of insurance firms remained limited. By the 1960s, for instance, the GAD employed one full-time employee and one part-time senior employee tasked with insurance supervision (Daykin, 1992).

In the latter half of the twentieth century, the stringency of insurance supervision gradually increased. By 1992, for instance, the GAD employed 17 actuaries working full-time on insurance supervision (Daykin, 1999, p. 530). Regulations, moreover, had cemented the position of actuaries within insurance firms. The 1973 Act required every company to have an 'appointed actuary', who would be responsible for producing the company's regulatory returns. The appointed actuary, in other words, was part of the company's management team and had

responsibilities towards the Department of Trade and Industry to protect policyholders (Johnston, 1989, p. 28).

Around the turn of the century, the pace of change picked up drastically. The guaranteed annuity crisis and the collapse of Equitable Life led to the perceived failure of traditional actuarial methods accurately to represent insurers' 'true' solvency position. The deterministic methods that actuaries typically used (using point-based estimates of key variables), had failed to account for the 'time value' of insurance guarantees, and in the net premium valuation method, moreover, future bonuses were accounted for only *implicitly*. This, critics argued, had obfuscated insurers' 'real' liabilities. The Penrose Inquiry concluded, for instance, that the 'regulatory returns and measures of solvency applied by the regulators did not keep pace with developments in the industry... regulatory solvency became an increasingly irrelevant measure of the realistic financial position of the Society' (Penrose, 2004, p. 727).

When the fall out of the maturity guarantees crisis was in full swing, the UK's newly integrated financial services supervisor, the Financial Services Authority, decided to overhaul the epistemic machinery underpinning the production of regulatory returns. Although European efforts to revise the calculative framework of regulatory solvency were already on their way (starting in 1997 – see chapter 7), the FSA also noted that 'the [current] EU minimum is widely regarded ... as inadequate' (FSA, 2002b). This was especially problematic in the early 2000s when after the bursting of the Dotcom bubble stock markets were persistently in decline. The FSA proposed simply to increase the EU minimum requirements. The industry, however, railed against this proposition. Although many conceded there was a need for more stringent capital standards, they also argued that regulatory capital requirements should reflect the 'real' risk embedded in an office's liabilities. By simply raising capital requirements, companies that had been more prudent would nonetheless be required to hold more capital at a time when the value of their assets was significantly depressed. For them, simply raising capital requirements would lead to "‘margins upon margins’, overstating the provisions required' (Dullaway and Needleman, 2004, p. 187).

To extricate itself from this conundrum, the FSA pursued the implementation of a ‘twin-peaks’ regime. In this regime, insurers had to measure their liabilities in two ways (yielding two ‘peaks’). The first peak comprised a traditional valuation as prescribed by the principles put down in the EU’s Third Life Directive (see chapter 7), and a measure of the solvency margin using the EU’s formulaic approach. The second peak, however, comprised two new devices: a ‘realistic’ valuation of insurers’ assets and liabilities (resulting in a ‘realistic balance sheet’) and firms’ own ‘risk-based’ assessment of capital requirements (the individual capital assessment or ICA). A realistic valuation of with-profits liabilities, the then chairman of the FSA Howard Davies explained in October 2002, should take into account both discretionary benefits and the time value of options, as well as the benefits that were guaranteed. The realistic balance sheet, moreover, should be calculated using ‘the same techniques as are used by banks and other participants in the capital markets’ (Davies, 2002). For the ICA, the FSA required companies to measure their risks with stress and scenario tests. A company’s capital requirements would be equal to the higher of the two peaks, the idea being that the second peak would reflect a company’s real risk profile. In contrast to the previous valuation regime, the realistic balance sheet would not contain any ‘implicit margins’, but would provide an ‘objective, best-estimate’ of the value of a company’s liabilities and the risks contained within them.<sup>16</sup>

Changes in the evaluation practices underpinning insurance regulation were thus facilitated by the decline of actuaries’ epistemic authority. The more ‘objective’ models of modern finance theory circumvented the need for actuarial discretion and prudence in matters of financial risk. This is not to say, however, that the application of techniques from modern financial economics was straightforward; as suggested by meaning finitism, it required implicit or explicit decisions to be made (see chapter 2).

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<sup>16</sup> The choice for market-consistent valuation, moreover, articulated well with international developments in accounting and solvency regulation. As noted above, the EU had started a project to harmonise European insurance solvency regulation in the late 1990s. At the same, the International Accounting Standards Board started development of an accounting standard for insurance contracts in line with the fair value approach. Both developments seemed to move towards market-consistent valuation. However, while the FSA rapidly unfolded a market-consistent regime, the International Accounting Standards Board did not. An international ‘fair-value’ accounting standard was agreed upon only in May 2017 and will come in force after January 2021.

When the new regime was announced, most insurance companies did not have the appropriate machinery in place to perform the calculations required for the second peak. Indeed, John Hibbert remembers that regulators ‘were aspirational... [A]t a higher level [they] could define what they wanted, but they had no real idea how it was going to be delivered’ (Hibbert interview). The FSA (2003) considered ‘realistic reserving methods’ a ‘developing art’. Given the relatively underdeveloped state of these realistic reserving methods and the fact that the stochastic simulation methods discussed in chapter 3 were readily available, what can explain the uptake of modern finance theory in the context of life insurance? Before addressing this question and describing how the ‘developing art’ of realistic reserving was developed into a full-blown epistemic machinery (in this chapter I focus mainly on valuation; risk measurement and management is dealt with in the next chapter), I first examine the environment in which no-arbitrage models were developed and deployed.

## No-Arbitrage Modelling and Modern Finance Theory

By the turn of the century, financial economics was a nascent academic specialism, which had gained significant traction in financial markets (Whitley, 1986; MacKenzie, 2006). Economists had traditionally paid little attention to finance, and, similarly, business finance scholars had shown little interest in the theories and methods used by economists. From the 1950s onwards, this started to change (Whitley, 1986). Although financial economics ‘had started as separate streams’, by 1970 these were ‘seen as parts of a largely coherent view of financial markets’ (MacKenzie, 2006, p. 66). One of the streams, for instance, concerned itself with the analysis of stock prices, the central proposition in the field being the ‘efficient market hypothesis’. The efficient market hypothesis, which had famously been formulated by Eugene Fama (1965, 1970) and built upon the earlier claim that stock prices follow a ‘random walk’ (a topic that was also discussed in chapter 3), put forward the suggestion that markets were efficient and at all times would reflect all available information in prices. In other words, it would be impossible to predict whether prices would move up or down over time. Other streams included ‘modern portfolio theory’ (Markowitz, 1952; Treynor, 1961; Sharpe, 1964; Lintner, 1965), which focused on analysing the value of a stock not in isolation but as part of a larger



portfolio of investments, and research into questions such as whether companies' capital structure mattered for their value (Modigliani and Miller, 1958).

The most influential work emanating from financial economics, however, came later: the Black-Scholes-Merton model for pricing options. Option pricing had been a long-standing puzzle in finance. The owner of a stock option has the right but not the obligation to purchase (or, in the case of a 'put option', sell) the underlying stock at a predetermined price. An option's payoff thus depends on the price of the underlying stock, a relation that for a long time had been difficult to describe mathematically. The option pricing model developed by the Chicago economist Fischer Black, and the MIT economists Myron Scholes (1973) and Robert Merton (1973), sought to provide an alternative to the rules of thumb on which practitioners traditionally relied. The Black-Scholes-Merton model draws on arbitrage arguments, which had readily been used in a different context by Modigliani and Miller, and suggests that an option's payoff can be replicated by a portfolio of shares in the underlying stock and 'risk-free' bonds in continuously adjusted proportions.<sup>17</sup> Following the arbitrage logic (and some simplifying assumptions), the price of the option should then be equal to the price of the 'replicating portfolio', for if not, arbitrageurs could potentially make a 'riskless profit' by buying or selling the option and 'hedging' their risk by buying or selling the replicating portfolio, depending on their relative prices. In pursuing these strategies, the actions of arbitrageurs would contribute to the convergence between the price of the option and the price of the 'replicating portfolio'. The model's solution to the problem, the Black-Scholes equation, expressed the price of a stock option in terms of time, a risk-free interest rate and the volatility and price of the underlying stock.

The importance of the Black-Scholes-Merton model went much further than this specific problem solution, which was limited to 'European options' and ignored

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<sup>17</sup> In fact, Black and Scholes had derived their famous Black-Scholes equation from the capital asset pricing model central in modern portfolio theory. It was Robert Merton's paper that provided the no-arbitrage arguments that would later become so influential. Hence, the model is appropriately referred to as the Black-Scholes-Merton model (see MacKenzie, 2006, pp. 135–136).

dividends.<sup>18</sup> It provided an ‘exemplary problem solution’ that by analogical extension indicated how other problems in financial economics could be reformulated and solved (MacKenzie, 2006, p. 139), and ‘became the central paradigm ... of financial economics’ (MacKenzie and Millo, 2003, p. 109). In subsequent years, a host of ‘no-arbitrage’ models were developed, some of which were intended to express the intuition behind the Black-Scholes-Merton model in more general theoretical and mathematical terms. Notable, for instance, was the work of Stephen Ross and John Cox, who ‘showed that the determination of option prices in [the way suggested by the Black-Scholes-Merton model] was equivalent to the principle of “risk-neutral valuation”’ (MacKenzie, 2006, pp. 139–140), a principle that did not just apply to options, but to all asset classes. It suggested that all assets could be valued by assuming that they would yield an expected return equivalent to the risk-free rate and then discounting all projected cash flows using the risk-free discount rate.

Asset pricing theory found an even more general mathematical expression in the work of the operations researcher Michael Harrison, the economist David Kreps (both at Stanford University) and Stanley Pliska, an operations researcher at Northwestern University. Building on the work of Cox and Ross, Harrison and Kreps (1979) and by Harrison and Pliska (1981) proved mathematically that if a market is ‘frictionless’ and free from opportunities for arbitrage, it is possible to assign a probability measure (an ‘equivalent martingale measure’ in mathematical terms) characterising potential future price trajectories such that the price of a derivative on that asset is simply the *expected* payoff discounted to a present value. Moreover, in a complete market (that is, a market in which all risks can be hedged) there is a *unique* probability measure: the ‘risk-neutral measure’ implied in the work of Cox and Ross (MacKenzie, 2006, pp. 140–141). Harrison and Kreps had produced mathematical proof that in a ‘frictionless’ and ‘complete’ market, and in the absence of opportunities for arbitrage, every asset could be assigned a price by assuming that all assets provided the same ‘expected rate of return’, the ‘risk-free rate’ – a complicated

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<sup>18</sup> In contrast to an American option, which can be exercised at any point in time, a European option can only be exercised at maturity. This makes the analysis of a European option relatively simple compared to that of an American option.

proposition that nonetheless proved useful in a wide variety of settings (Chiapello and Walter, 2016). As MacKenzie argues, with the publication of Harrison and Kreps's propositions, 'the basic structure of "orthodox" modern finance theory was essentially complete' (MacKenzie, 2006, p. 141). The papers by Harrison, Kreps and Pliska 'turned financial economics into mathematical finance' (Davis & Etheridge 2006, p. 114).

Although no-arbitrage models rely on what are often considered rather arbitrary assumptions about how financial markets work, they became hugely influential. What makes no-arbitrage models like the Black-Scholes equation distinctive (and perhaps powerful) is that they seek to calculate value 'synchronically' (Langenohl, 2018). The Black-Scholes equation 'posits the existence of a specific socially imagined totality, *the market*' (LiPuma, 2017, p. 2; emphasis in original). The model, which requires an extensive set of assumptions to make the problem mathematically tractable, 'exteriorizes the social structuring of the market, setting aside both the objective structures of the financial market and the motivating structures embodied in its agents' (LiPuma, 2017, p. 3). In so doing, the model does not provide an accurate description of real financial markets but constructs an idealised image of their underpinning 'objective structures', an image that allows the formulation of useful practical devices such as the Black-Scholes equation. It allows, in other words, the relation between prices and volatility of different assets (enforced through the logic of arbitrage) to be expressed in mathematical terms. Those who use the Black-Scholes equation in practice rarely believe that it describes financial markets accurately, but tend to argue that it helps to perceive, orientate and structure financial action – perhaps in ways that make markets more 'rational' (MacKenzie, 2006; Millo and MacKenzie, 2009; Svetlova, 2009). Models like the Black-Scholes equation are understood to be objective, because they circumvent the need for the formation of 'expectations' about future financial market behaviour, which is normally required to value assets whose pay-offs are uncertain.

No-arbitrage models have a certain ‘ontological dignity’, which is reflected by the distinction that is often made between the ‘real world’ and the ‘world contained within the model’. Take for instance Chiapello and Walter, who recently wrote:

For calculative purposes the “new finance” has imagined a new world, the risk-neutral world, in which all invested assets are assumed to provide the same expected rate of return, namely the risk-free rate, regardless of the risk of each specific asset. This purely mathematical transformation certainly has major financial virtues. (Chiapello and Walter, 2016, pp. 163–164)

Similar distinctions may surface in the language of practitioners. They may speak for instance speaks of the ‘Black-Scholes world’ and the ‘no-arbitrage world’, a world that satisfies assumptions underpinning no-arbitrage models and in which opportunities for arbitrage are absent (Kemp, 2009).

The construction of a ‘model world’ allows no-arbitrage modellers to see things that others cannot see. ‘[K]ey to the ontology of no-arbitrage models’, as MacKenzie and Spears (2014b, p. 399) point out, are the martingale or risk-neutral probabilities referred to earlier. These are central in the derivatives quant culture studied by Spears (2014). No-arbitrage modellers do not assign ‘real world’ probabilities (which are not to be confused with ‘realistic’ estimations of value) to the possible future price trajectories of an asset (probabilities that are based, e.g., in archival-statistical analysis), but rather describe such price trajectories with a probability distribution that reflects the expectation that future prices will on average be equal to today’s price. Risk-neutral probabilities ‘are simultaneously less real and more real than actual probabilities’ (MacKenzie and Spears, 2014b, p. 400). They are less real in the sense that they do not describe true expectations; they are more real because they provide access to the ‘objective’ value of an asset. No-arbitrage models thus posit a specific ontology or a particular way of viewing the economic world, which sees the world of finance as an objective totality held together by the logic of arbitrage.

Although finance practitioners initially tended to be sceptical or even hostile towards early financial economics, a ‘significant body of practitioner opinion came gradually to embrace at least some of [its] conclusions’ (MacKenzie, 2006, p. 87).

Particularly influential was the Black-Scholes equation, which entered the trading floor of the Chicago Board Options Exchange in the form of paper sheets as early as 1973. These devices, which described the relation between the volatility of the underlying stock, an option's strike price and its value, facilitated communication between actors on trading floors, allowing for the easy comparison between option prices at different strike prices and maturities because they could be expressed in a single figure: their 'implied volatility' (MacKenzie and Millo, 2003; MacKenzie, 2006; Svetlova, 2018a). In so doing, no-arbitrage models facilitated the development of novel trading strategies (Beunza and Stark, 2004, 2012).

By allowing the 'backing out' of assets' 'implied volatility', no-arbitrage models also contributed to developments in risk analysis and management (Millo and MacKenzie, 2009). 'Backing out', which allows modellers to deduce a 'market implied volatility' for a given from the observable market prices of the asset and a derivative on the asset, facilitated the evaluation of risk for large portfolios. Quantitative risk management, moreover, helped justify economic capital allocation decisions (Lockwood, 2015) by allowing for comparisons between the risk-reward trade-off of different portfolios (Holton, 2002; Kavanagh, 2003; Rosen, 2003). No-arbitrage models thus not only endowed derivatives with legitimacy (MacKenzie and Millo, 2003; de Goede, 2005b) but also rationalised and justified the proliferation of derivatives and structured products (Dionne, 2013). An early example is portfolio insurance, a 'synthetic put option' on a market portfolio implemented through the kind of dynamic hedging strategy implied by the Black-Scholes-Merton model (Leland and Rubinstein, 1988; MacKenzie, 2006). Other innovations included credit derivatives, interest rate swaps, caps and floors, and collateralised debt obligations (see: Dionne, 2013).

Finally, the cultural authority of financial economics and the concomitant proliferation of derivatives (the value of which was difficult to account for using traditional accounting techniques), influenced accounting practice too, manifested by the ascendancy of 'fair-value' accounting. Preceding conceptual frameworks for accounting had increasingly put emphasis on the economic meaning of the balance sheet, rather than its legal meaning; fair-value accounting, with its emphasis on

market value, thus promised to enhance the economic relevance of accounting representations (Power, 2012, pp. 301–302). Fair-value is an accounting technique that seeks to make use of market prices and is also referred to as a mark-to-market approach. Fair value is typically defined as ‘the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date’ (Laux and Leuz, 2009, p. 827). When sufficiently relevant market prices are not available, quoted prices of similar assets or hypothetical market prices produced by an economic model may also be used.

With its focus on observable market prices, fair value accounting is often to be more reliable and relevant. Critics, however, point to some important limitations too. In practice, relevant market prices are not always readily available, meaning that many fair-value representations are mark-to-model rather than mark-to-market, giving accounting representations somewhat of an ‘imaginative’ character (Laux and Leuz, 2009; Müller, 2014; Zhang and Andrew, 2014), potentially compromising the ‘reliability’ of the accounting representation (Ronen, 2008). Fair-value accounting, moreover, may strengthen procyclical tendencies, inflating the value of a firm in good times thereby allowing it to become more highly leveraged (or to take on relatively more debt), while deflating it in poor ones (cf. Laux and Leuz, 2009, pp. 829–830). As discussed below, these issues surfaced in the context of insurance valuation too.

## From No-Arbitrage to Market-Consistency

Having described the key features of no-arbitrage modelling, how can we explain their uptake in the field of life insurance? Even if the epistemic authority of traditional actuarial methods was on the wane, it does not yet explain why the insurance sector embraced no-arbitrage modelling, especially considering that stochastic simulation techniques such as the Wilkie model (models that were also capable of accounting for the ‘time value’ of guarantees) were more readily available. When the FSA required insurers to use the same techniques as are used in banking to quantify their liabilities, it was not the first time no-arbitrage models were discussed within the actuarial field. Views on the usefulness of no-arbitrage models,

however, tended to diverge. Discussions of the merits of the Black-Scholes equation in particular, and, more generally, modern finance theory first appeared in the profession with the issue of maturity guarantees on unit-linked business (see chapter 3). The Irish actuary Colm Fagan had suggested an approach to managing the risk of insurance guarantees that was very similar to that suggested by option pricing theory. Moreover, a former colleague of Scholes and Merton at MIT, Michael Brennan, and his doctoral student Eduardo Schwartz (Brennan and Schwartz, 1976, 1979), and the Irish actuary and economist Phelim Boyle (Boyle and Schwartz, 1977), all at the University of British Columbia, had published papers in finance journals indicating how option pricing theory could be used to price such guarantees.<sup>19</sup> The Maturity Guarantees Working Party had examined the possibility of using option pricing theory, but it reached a (predominantly) negative conclusion; to them, option pricing theory seemed ‘to have serious practical disadvantages because it depends upon several underlying assumptions’ (Ford *et al.*, 1980, p. 112).<sup>20</sup> A similar conclusion was reached by the actuary Thomas Collins, who published a paper two years later arguing ‘that the theory ... is not practical enough’ (Collins, 1982, pp. 281–282). Actuaries thus acknowledged that option pricing theory could in principle be extended analogically to maturity guarantees on unit-linked contracts, but regarded it of limited practicality, because of its foundational assumptions and the discrepancy between the near-term expiries of exchange-traded financial options and the long-

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<sup>19</sup> The possibility of drawing an analogy between insurance guarantees and financial options was remarked on in other places too. When, for instance, Myron Scholes and Robert Merton were awarded the Nobel Prize in 1997 (Black had died by that point), the press release contained the following comment: ‘A similar method [as the Black-Scholes-Merton model] may be used to value insurance contracts and guarantees. ... A guarantee gives the right, but not the obligation, to exploit it under certain circumstances. Anyone who buys or is given a guarantee thus holds a kind of option. The same is true of an insurance contract. The method developed by this year’s laureates can therefore be used to value guarantees and insurance contracts. One can thus view insurance companies and the option market as competitors’ (The Royal Swedish Academy of Sciences, 1997).

<sup>20</sup> This is how Phelim Boyle, who was well respected in both the British actuarial profession and amongst financial economists, recounts this episode: ‘After a short stint in Liverpool with a firm of consulting actuaries, I moved in 1973 to the University of British Columbia in Canada. The Dean, Philip White, was building a finance department and had recently hired Michael Brennan and Bob White from MIT, both of whom had learned about modern option pricing theory from Scholes and Merton. I recall giving an early seminar to the finance group and mentioning the problem of the maturity guarantees. Michael excitedly pointed out that this contract was a put option and that it could be priced and also hedged using the Black Scholes Merton technology. We wrote a few papers on how maturity guarantees could be handled in an option framework. This approach was treated with some healthy actuarial scepticism by the Maturity Guarantees Working Party’ (Boyle, 2005, p. 592)

term nature of insurance guarantees. With-profits liabilities were entirely out of the question.

By the mid-1990s, however, a new generation of actuaries had emerged, who were avid proponents of modern finance theory. According to Turnbull (who was one of them), the generation consisted of actuaries who had practical experience with modern finance theory in a variety of different professional ecologies (Abbott, 2005; Seabrooke and Tsingou, 2009) – they ‘had independently developed expertise in financial economics and who worried that the British actuarial profession was dangerously behind other financial professionals’ (Turnbull, 2017, p. 216). Among its members was Andrew Smith, a consulting actuary at Bacon & Woodrow (the insurance branch of which was acquired by Deloitte in 2000), who, after having been ‘seconded to an investment bank’ in the early 90s, became familiar with an approach to valuation ‘completely different from the way that actuaries did it’ (Smith interview). Smith became a leading proponent of ‘the investment banking way of doing things’ and with his economic scenario generator (the ‘Smith model’), Deloitte became Barrie & Hibbert’s main competitor. Craig Turnbull, who started his actuarial career at Watson Wyatt before moving to Barrie & Hibbert where he was the ‘fifth man’ and where he finished his actuarial qualification in 2003 (Turnbull interview). Other members included David Dullaway, who, rather unusually, had a background in economics, Malcolm Kemp, Jon Exley, Shyam Mehta, Cliff Speed, David Bowie, and the academic actuaries Andrew Cairns and Angus Macdonald, both at Heriot-Watt University’s actuarial department (Turnbull, 2017).

In the late 1990s, the merits and demerits of modern finance theory were discussed within the profession with increased frequency. The debates often incited great passion. David Dullaway, for instance, remembers ‘one public meeting ... where somebody actually stood up and called me a traitor to my profession’ (Dullaway interview). According to Dullaway, some actuaries perceived the emergence of modern finance theory as a direct threat to traditional actuarial approaches.

There’s a lot of people here who have senior positions, it’s a very well respected profession, and I’m saying: everything you’ve been



doing for the last ten, twenty years has simply been wrong. At least that's what they felt I was saying. ... There was a real backlash of: "you can't say that, because if you're right everything that we're doing is wrong". (Dullaway interview)

The main objections against the use of no-arbitrage models in an actuarial context (mimicking those of the earlier debates discussed in chapter 3) were that the models were based on unrealistic assumptions and that the mathematics required to implement such models in actuarial practice was too complex. One of the main critics of modern finance theory and avid defender of an 'actuarial approach' was the actuary Robert Clarkson. Apart from various commentaries in *The Actuary*, Clarkson published two papers, one entitled 'Financial Economics: An Investment Actuary's Viewpoint' (1996), the other 'An Actuarial Theory of Option Pricing' (1997), criticising the 'unrealistic' approach of modern finance theory and suggesting alternatives. The new generation of actuaries, though, was quite numerous and its members attended many of the Institute and Faculty's sessional meetings, including those in which Clarkson presented his paper. They criticised, in particular, Clarkson's use of mathematics. Macdonald, for instance, noted that Clarkson 'has no desire to allow the precision of mathematical argument to stand in the way of his assaults on his chosen targets' (Macdonald in Clarkson, 1996, p. 959). Similarly, David Wilkie, whose earlier contributions to actuarial science had led both the Institute and Faculty of actuaries to award him a gold medal and who was rather more hesitant about the merits of financial economics than some of the younger actuaries, criticised Clarkson's use of mathematics. He ended his contribution to the debate by stating: 'I have been depressed by the discussion. It is, I am afraid, a dialogue of the deaf, between those who know something about statistics, about financial economics and about mathematics, and those who do not. I am really very discouraged that the Faculty should have brought forward such a paper' (Wilkie in Clarkson, 1996, p. 961).

As predicted by Abbott's (2005; see also: Seabrooke and Tsingou, 2009) 'linked ecologies' approach, a key factor in the uptake of modern finance theory was that advocacy of modern finance theory allowed the younger generation of actuaries to form a coalition with other actors in the insurance field (shareholders) and in the

adjacent field of investment banking (derivatives department seeking to sell risk management solutions). Towards the late 1990s, the younger actuaries, who had become familiar with modern finance theory by traversing across different fields, started outlining how the methods of modern finance theory could be applied to insurance valuation, which they argued produced superior knowledge for e.g. investors about the economic value embedded in insurance operations. Other papers outlined more generally how financial economics could be applied in an actuarial context (Smith, 1996), how modern finance theory could be used to value pension funds (Exley, Mehta and Smith, 1997; Head *et al.*, 2001), and how derivatives could be used to manage the financial risk embedded in insurance and pension arrangements (Kemp, 1997).

A key actor group in this regard were the supervisors. The integration of banking and insurance supervision in the Financial Services Authority, or FSA, in 1997 was crucial for creating a critical mass within the supervisory agency to favour the risk management techniques of modern finance. The emergence of the FSA manifested a broader development towards a model of statutory regulation, in which regulatory and supervisory tasks are performed by an independent expert agency that would take a stronger stance in epistemic issues (Majone, 1996). Initially, it seemed the transition was mainly organisational. Although the FSA initially continued the regulatory principles and practices of the previous regime, it also implemented some key organisational changes. As interview data suggests, organisational reform contributed to the declining position of supervisors with an actuarial background. In contrast, supervisors with experience in banking acquired a more dominant role in insurance supervision. Changes internal to the supervisory agency, in other words, provided opportunities for actors in the epistemic field of actuarial science favouring more explicit use of modern finance theory – particularly the use of no-arbitrage modelling for valuation purposes and risk management – to gain the backing of key state actors. Indeed, in the early years of the new millennium, this resulted in the publication of various consultancy reports (e.g. Barrie & Hibbert, 2002) and actuarial research papers (Hare *et al.*, 2000; Hairs *et al.*, 2002; Whelan, Bowie and Hibbert, 2002; Hibbert and Turnbull, 2003; Dullaway and Needleman, 2004; Sheldon and Smith, 2004).

As noted above, regulators considered market-consistent valuation more objective than traditional valuation methods, because no-arbitrage models seemed to isolate the objective structures of finance. Market-consistent valuation, therefore, appeared to articulate well with the statutory model of regulation. As a supervisor put it: ‘if you're producing a standard that has got to be audited, you've got to reduce the discretion available for firms’ (interviewee BB). Craig Turnbull indeed suspected that the perceived objectivity of no-arbitrage modelling made it attractive for a system of statutory regulation:

I think one of the fundamental attractions to adopting these approaches, for the regulator in particular, and maybe for the accountants and others, was this idea that you could get to an objective measure of these costs in a way that removed actuarial judgment or actuarial judgment or strange actuarial assumptions that no one else understood. You know, you mark-to-market and there's market prices. You use them. And that was your price, and it would be this objective single answer. (Turnbull interview)

Although market-consistent modelling was considered more objective, modellers were well aware that important decisions had to be made. As noted above, the FSA considered realistic reporting, for instance, a ‘realistic art’. This is because, as Dullaway noted, ‘a lot of the stuff that ... comes out of finance and banking isn't directly applicable because the products are different’ (Dullaway interview). The differences with financial instruments complicated the extension of no-arbitrage models to insurance liabilities.

We are not dealing with a market in which all the instruments are traded both ways. You cannot decide arbitrarily to buy or sell a life insurance policy. Also, the very notion of doing so only considers the pure investment part of the risk, and ignores all other aspects of a with-profits policy, such as the pooling across generations and the smoothing. (Macdonald in Hare et al., 2000: 208)

The prices of insurance guarantees cannot in practice be enforced by arbitrage and the ‘no-arbitrage’ prices that could be assigned to insurance guarantees only considered the cost of investment risk, not of their insurance-related risk. Moreover, the value of insurance guarantees on with-profits policies typically depends on multiple random variables at once (including, e.g., interest rates, inflation, equity prices and real-estate prices), and, crucially, the *correlation* or *dependency* between

them. The valuation of insurance guarantees, in other words, is an *imperfect market problem* in the sense that not all assets required to hedge those guarantees are available. Insurers' models were therefore not referred to not as no-arbitrage models, but as 'market-consistent' models, a concept that in the words of Kemp (2009: 1) is 'a catch-all for the activity of taking account of "what the market has to say"'.

## Building Models, Shifting Between Worlds

The perceived complexity of insurance guarantees had some important consequences for the technological features of the market-consistent valuation machinery. The Black-Scholes equation and some other no-arbitrage models were 'analytical', 'closed form' solutions. According to Parit Jakhria, an actuary with a background in stochastic calculus who developed the in-house asset-modelling engine of Prudential, if the valuation problem 'was completely simple, you could try and use a closed form solution like Black and Scholes. Trouble is, none of these [insurance guarantees] were simple, and hence you had to use a Monte Carlo [simulation]' (Jakhria interview). Because the value of insurance guarantees depends not just on one stochastic process (e.g. the price of a single stock option), but multiple (e.g., interest rates, the stock market index, real-estate prices), it is necessary to model a range of processes at once. An economic scenario generator allows doing just that. Having used the scenario generator to produce a set of scenarios, one can calculate the value of a policy's underlying fund in each of the scenarios and, by discounting the payoff of the policy in each of the scenarios to a present value and averaging across all scenarios, one can then obtain its value.

In the early years of market-consistent modelling, there were two competing approaches. Barrie & Hibbert's scenario generator, which was widely used, was risk-neutral (i.e. it produced scenarios in which all assets *on average* would produce a risk-free rate of return). The mathematician Andrew Smith, who worked at Bacon & Woodrow (the insurance branch of which was acquired by Deloitte in 2000), however, developed an alternative model that was 'mathematically equivalent' but remained within a 'real-world' setting. According to Smith:

...at the time not many actuaries understood risk-neutrality. It was not something that was in the actuarial exams, it was not something that was well explained. If you showed an actuary a risk-neutral model, they would likely say: 'well that's obviously nonsense because we know over the last hundred years equities have outperformed bonds by 4 percent, 5 percent, whatever it is. (Smith interview)

Indeed, Dullaway confirms, the shift towards a risk-neutral world, where all assets are *assumed* to yield the same returns as the 'risk-free' government bonds for pragmatic reasons, posed interpretative difficulties: 'it did cause a lot of difficulty in terms of conceptual understanding for quite a period' (Dullaway interview).

Modellers described risk-neutral valuation as 'a neat trick' and likened risk-neutral probabilities to 'pseudo-probabilities' that provide 'a neat short cut to the correct answer every time' (Whelan *et al.*, 2002, pp. 57–59).

Smith, however, noted that risk-neutral valuation was not the only way to solve no-arbitrage pricing problems. Indeed, the problem solution of Harrison, Kreps and Pliska, which was discussed earlier in this chapter, indicated that other solutions were possible too. While the risk-neutral approach solved the valuation problem by adjusting the probability measure so that *all* cash flows could be discounted using *the same* discount-curve, Smith recognised the possibility of using 'state price deflators', which, he suggested, is a 'stochastic generalisation of a discount factor' (Smith, 1996, p. 1121). Thus, instead of assuming a 'risk-neutral world', which required some familiarity with option pricing theory, deflator models would simply start from 'real-world' projections of cash flows and then define a stochastic discount factor consistent with the assumption of no-arbitrage – i.e. a discount factor that would return market prices when applied to the real-world projection of cash flows (see, e.g.: Jarvis, Southall and Varnell, 2001).<sup>21</sup> According to Smith, 'the deflator was a way of explaining, well, this is how you get from a realistic-looking model to something that replicates market prices... It was actually more a cosmetic difference

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<sup>21</sup> A stochastic discount factor, in other words, is a variable discount factor that produces a discount rate consistent with a particular scenario. The changes in the discount factor relative to the risk-free rate are at least in principle directly proportional to the adjustment from a realistic projection of a derivative's underlying asset to a risk-neutral projection.

than anything else. Those two models calibrated the same way would produce pretty much the same answer' (Smith interview).

While the scenarios produced by deflator models may have been easier to understand, the risk-neutral valuation models were easier to implement. Financial mathematicians had primarily built models of the latter type, which meant there was a rich repository of already developed models from which the modellers in insurance could borrow. Initially, the construction of the 'risk-neutral economic scenario generators' consisted primarily of bricolage. As the physicist and former modeller at Barrie & Hibbert Steven Morrison explains: 'What we were basically doing was picking up those models that were already used for valuation problems [in banking] and ... putting them all together in one large model... almost sort of glue them together into one model' (Morrison interview). Barrie & Hibbert, in other words, 'patched together off-the-shelf banking models that you could get from textbooks ... that aren't really supposed to work together' (interviewee CJ). The Smith model similarly started 'out of things that were out there in the public domain', but later included a mix of both deflator and risk-neutral enabled models (Smith interview).

Although mathematically the choice of approach was considered primarily a 'cosmetic difference', it potentially had some important implications – implications that have to do with the relation between risk-neutral and real-world scenarios. Theoretically, it should be possible to move between the two model worlds by applying a 'change of measure', which is equivalent to Smith's 'state price deflator'. Risk-neutral models were simply calibrated to reproduce observable market prices by 'back-solving' for the volatility of the underlying asset, yielding a 'market implied volatility'. '[I]n theory', Smith explained, 'that volatility ought to be consistent with historic volatility, but in practice it never is'. Subsequently, he continued, 'we discovered ... that a model which would replicate market prices was not, in mathematical terms, absolutely continuous with respect to any credible model of real worlds' (Smith interview). This is because the 'change of measure argument relies on all sorts of assumptions that don't actually hold true in the real world' (Morrison interview). No-arbitrage models, for instance, assume trading to be 'frictionless', a condition that few would argue holds true in practice.

The choice of calibration method therefore matters. It is well known that ‘historically option implied volatility has been higher than the corresponding real-world volatility’ (Morrison interview), which is another way of saying that market prices exceed the prices produced by a model calibrated to real-world parameters. As Morrison explained, this leaves modellers with a conundrum:

If you use the option implied volatility, you’d probably be overstating ... the real-world volatility. If you use the real-world volatility, you would under-price options. So if you want to use the same model for two different things, constraining yourself by the theoretical straitjacket means you're actually doing neither of those things particularly well, so we've always argued to actually ... focus our attention on the job at hand. If you're interested in pricing options, you look at the option market and ... implied volatility. (Morrison interview)

For some ‘sizeable problems’, Smith argues, whether you calibrated to historic volatility or market implied volatility ‘really mattered’. For instance:

if you are an insurer and you’ve written some liabilities that had guarantees and you were considering whether to hedge or not, if you use ... [a] model calibrated to market prices of options, then hedging always looked like a fantastic idea, because you got rid of all these risks of things going wrong, and you would just pay a fair price for the option, whereas if you used the historic calibration it’s much more a trade-off, because you think the volatility is going to be 15%, the market is charging 20%, but ... when you’ve paid that 20, you've got some peace of mind ... you're no longer exposed to your model being wrong. (Smith interview)

The calibration method matters for decision-making. In practice, therefore, the scenario generation software of both competitors will include tools to generate scenarios both in a real-world and risk-neutral setting. (For market-consistent valuations, for instance, the risk-neutral setting will typically be used.) Although it is difficult to assert (and outside the purview of the methods that I deploy here) to what extent calibration methods have influenced insurers’ investment decisions, the crucial point here is that seemingly minor technical details may have important consequences for what courses of action appear desirable.

The calibration of models in either a real-world or a risk-neutral setting comes with different challenges. Real-world modelling (used, e.g., for risk management

purposes) is limited by the availability of relevant data; calibrating a model to market prices is limited by the availability of relevant market prices. Take for instance the calibration of a stock-market model, which requires stock-index option prices going as far out into the future as, say, twenty years. Prices for such options are not readily available. This may have important implications:

[T]he shorter term options have more weight in the calibration, but when we look at the longer term options, we're essentially extrapolating towards something which is informed by our real-world views. Because we don't have ... market information ... you're sort of constructing a pseudo-option-implied vol[atility] in the long term ... using real-world assumptions to inform what an implied volatility might look like. (Morrison interview)

This calibration issue was especially challenging in the early years, as a former regulator explained, when there were a 'vast number of insurance liabilities being valued on the back of a handful of transactions' (Chamberlain interview). Modelling firms such as Barrie & Hibbert and Deloitte had set up panels of investment banks who would supply them with over-the-counter quotes for longer-term derivatives. But when banks realised they were not obliged to sell options contracts at those prices, 'regulators started to worry those prices were artificial' (Chamberlain interview). Regulators pushed for companies to show that they 'could actually deal at that price', but banks were reluctant to facilitate the hedging of, say, equities thirty years out. Calibrations of insurers' market-consistent models, especially in the long term, were necessary compromises between market-based estimates, on the one hand, and the real-world views and desire for profits of investment bankers, on the other hand; they were, therefore, less 'objective' and judgement-free than some perhaps initially hoped.

To sum up, the appropriation of no-arbitrage models in insurance was not simply a case of a straightforward application of already existing models to new domains. Rather, modern finance theory served as a repository of exemplary problem solutions and modelling techniques, based on which the idiosyncratic valuation problems of insurance could be addressed. The analogical extension of exemplars thus required decisions to be made, either implicitly or explicitly, decisions on which regulators and supervisors had an increasingly strong influence.



## Market-Consistent Modelling as a New Paradigm?

[I]t's like a Kuhnian paradigm shift had to happen before people would say: okay, yes, maybe you're right, now let's look at the details.... It was exactly like one of those shifts, like when Newton came along or when Einstein came along and the whole world changed. (Dullaway interview)

At least three of my interviewees, including Dullaway, experienced the transition from 'traditional actuarial modelling' to 'market consistent' modelling as a Kuhnian 'paradigm shift'. As noted in chapter 2, the Kuhnian account of scientific change provides little guidance if we want to understand why 'paradigm shifts' such as these occur. In following Barnes (1982), I argued that paradigms are best understood as exemplary problem solutions that may be more or less central in a given epistemic field. When there is a dominant paradigm, this needs not imply that it is the only paradigm. It may well be that different paradigms exist alongside each other; each paradigm, may, for instance, animate a different part of a given epistemic field, or, perhaps, may be used as exemplars for different problems. Paradigm shifts, in this sense, are changes in practice that are either abrupt or gradual and that are experienced as significant discontinuities.

In the case of actuarial science, it is difficult to identify a clear 'twentieth-century actuarial paradigm'. Indeed, proponents of modern finance theory suggest that the techniques and practices of actuarial science were rather diffuse and were not part of a coherent theory of value. Exley, Mehta and Smith (2000), for instance, distinguish between 'traditional actuarial practice' and modern finance theory by arguing that 'much of UK actuarial "science" is in fact no science at all, but rather a collection of ad hoc techniques evolving over time to suit the business objectives of clients and consultants'.<sup>22</sup> Modern finance theory, in other words, would give actuarial science its scientific basis. Surely, actuarial science had drawn on theory, like statistical theory or risk theory, but none of these theories had become a 'paradigm' proper – that is, none of the exemplary problem solutions through which

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<sup>22</sup> Of course, as scholars in science studies have shown, scientific activity can seem as ad hoc (e.g. Latour and Woolgar, 1986). The point is, however, that most practitioners perceive the methods of modern finance theory as a coherent theory, more so than traditional actuarial science.

the meaning of such theories was conveyed became a central point of reference for actuarial research. Risk theoretical models developed in the context of life insurance remained limited to the models discussed in chapter 3, most notably the Wilkie model.<sup>23</sup> As discussed in chapter 3, Wilkie's model had grown out of the analogical extension of exemplary 'risk theoretical' models to the problem of investment risk and became extensively used for a range of different purposes. Until the emergence of market-consistent models, however, it remained the only widely used stochastic model of financial risk in the industry.

Another important problem solution was Frank Redington's (1952) 'immunisation theory', developed in the mid-twentieth century (Shedden, 1977; see: Hare, 1989). Redington was chief actuary at Prudential and was a well-respected member of the profession (awarded a gold medal by the Institute in 1968), whose works addressed the typical problems of with-profits insurance: reserving, bonus policy and valuation (Turnbull, 2017, p. 106). Concerned with the volatility of interest rates and its potentially devastating impact on insurers' financial position, Redington, wondered whether such risk could be mitigated or 'immunised' by 'matching' the characteristics of an insurer's assets with those of its liabilities. Redington postulated that if the sensitivity of the value of an insurer's assets to the interest rate was equal to the sensitivity of the value of its liabilities to that same interest rate (which he both expressed mathematically as the first derivative of the respective values with respect to the interest rate) and the rate of change in the former was at least as great as the latter, then the total portfolio would be 'immunised' against interest rate risk. Although Redington's immunisation theory may have 'delivered a thunderbolt of much-needed clarity to the management of interest rate risk', as Turnbull (2017, p. 109) suggests, its concrete practical applications remained limited. 'For life offices ... it did not resolve the question of

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<sup>23</sup> In general insurance, risk theoretical models were much more widespread, but in the UK, actuaries remained relatively divorced from general insurance. In the context of life insurance, Wilkie updated his model in a series of papers (Wilkie, 1984, 1995). In the late 1990s, other models started appearing, some of which continued along the lines of Wilkie's time series model such as the TY model (Yakoubov, Teeger and Duval, 1999). Others, however, started developing market consistent models. In general, the 1990s was the period in which stochastic models started to proliferate (Jakhria *et al.*, 2019).

which liabilities it ought to be applied to' (2017, p. 109). Redington's model of immunisation depended on the assumption that an insurer's liabilities were non-arbitrary. In the context of with-profits, however, such liabilities depended on actuarial discretion. The question thus remained whether the theory should apply to guaranteed benefits, surrender values or whether it should also include bonuses, a question that remained unanswered.

Even though Redington's theory was quite influential in actuarial thought and sparked much debate on the matching of liabilities with assets, its paradigmatic influence was limited, partly because actuaries did not perceive Redington's representation of liabilities as accurate.<sup>24</sup> Interestingly, once the no-arbitrage models of modern finance theory started migrating into the epistemic field as exemplary problem solutions, actuaries started making analogies between the Black-Scholes-Merton model and Redington's immunisation theory. Crucial in this respect was the fact that the Irish actuary Colm Fagan had independently developed a concept for a dynamic investment strategy similar to that underpinning the Black-Scholes-Merton model. He presented his model as a 'generalisation' of Redington's immunisation, 'both being dynamic investment strategies designed to keep the market value of the assets and liabilities equal at all times by imposing certain constraints on the assets' (Whelan, 2002, pp. 34–35). In early contributions to the debate, dynamic hedging was often referred to simply as a form of immunisation and was seen as being of the same family as Redington's concept of duration matching (Ford *et al.*, 1980; e.g. Collins, 1982). However, as mentioned earlier, the 'immunisation approach' was initially not considered practical enough for actuarial use. When the new generation of actuaries familiar with modern finance theory entered the stage, the actuarial nomenclature was largely abandoned.

While the exemplary problem solutions of twentieth-century actuarial science remained somewhat diffuse, this changed with the FSA's imposition of market-consistent reporting. Compelled by regulations, actuaries now had a clearly defined

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<sup>24</sup> Redington's immunisation theory, moreover, only applied to interest rate risk. It did therefore not seem to have shaped actuarial thought on the risks that come, for instance, with equity and real estate investment in any direct way.

set of problems (the valuation of liabilities containing guarantees that were *similar* to financial options), for which a repository of exemplary problem solutions was available. This, however, is not to say that the development of market-consistent modes was in any way easy or that the choices to be made were trivial (the particularities of insurance liabilities presented idiosyncratic difficulties some of which are discussed in the previous section), but simply to say that the actuarial research agenda had been defined. This meant that actuaries with little knowledge of modern finance theory had to familiarise themselves with its exemplary problem solutions. In the 1990s, Dullaway recalls, ‘the examinations ... were teaching things which from a pure finance perspective didn't make sense’ (Dullaway interview). Only in 1999 did a basic exam in financial economics (and an option to take an advanced exam in derivatives pricing) become part of the actuarial curriculum. Consequentially, consultancy firms played an important role in familiarising actuaries with the exemplary problem solutions of modern finance theory. Craig Turnbull, who worked at Barrie & Hibbert at the time, remembers for instance that ‘a lot of our work, as well as doing all the modelling and [writing] papers ... was actually more education’ (Turnbull interview 1). ‘You were going along to clients and explaining what a market consistent valuation was, doing these simple examples’, Dullaway similarly recalls (Dullaway interview). The shifting demand for expertise was not only reflected in actuarial training but also in the hiring patterns of the firms that build the modelling machinery. As John Hibbert recalls, ‘we employed actuaries, we had economists, we had probably more physicists than any other background among our technical professional staff, but I think that was a bit of a departure for the profession’ (Hibbert interview 1).<sup>25</sup>

Once market-consistent modelling started to emerge in the late 1990s, the number of models proliferated quickly. Insurers started using market-consistent models not just to calculate the value of liabilities, but also to manage risk. The models used for valuation purposes, however, were not necessarily well suited for risk management purposes. For solvency calculations, accuracy was considered key.

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<sup>25</sup> Similarly, Prudential, the only UK firm that succeeded in building an in-house scenario generator, hired not only actuaries, but also people with a strong ‘programming and quantitative background, and ‘a number of CFAs [chartered financial analysts]’ (Jakhria interview).

Scenario generators were designed to minimise statistical errors. Dullaway explained that ‘if you're running only a thousand scenarios and average them, there's a good chance that you'll be out by one or two percent either side. But one or two percent either side when you're valuing a set of liabilities, which may be 50 billion, and you've got assets, which will maybe be 55 billion, okay, well, a one or two billion error can have a very big effect on your solvency’ (Dullaway interview). For ‘hedge diagnosis’, however, a model ‘wasn’t supposed to particularly accurately model your balance sheet. It was supposed to be able to work out [for example] a replicating portfolio ... management actually requires cruder models’ (Fulcher interview).

‘Replicating portfolio models’ (or simply ‘replios’) are an example of a type of cruder models often used for risk management purposes. Replicating portfolio modelling (which is not to be confused with the ‘replicating portfolios’ of the Black-Scholes-Merton model) is ‘a sort of simple top-down type modelling’ that provided a solution to the ‘nested stochastic problem’ (Fulcher interview). Market-consistent valuation of a book of liabilities requires the generation of a large set of economic scenarios, but doing so will only yield information about the value of your liabilities, not about *the sensitivity of those liabilities to different ‘stress factors’*. As Fulcher explained:

[T]he option itself is a stochastic model ... and you almost want to do another stochastic simulation on the stochastic simulation to work out what the value of that option might do over the next twelve months, if you see what I mean, and therefore what hedging strategy you need. (Fulcher interview)

Calculating the sensitivity of a set of liabilities to different ‘stress factors’ requires the simulation of an additional set of scenarios. As interviewee CJ, an actuary and physicist, said:

I probably need to do, I don’t know, maybe 5,000, 10,000 scenarios to get enough resolution in the tail for 1-in-200. ... I then need to revalue at every point there. And therein lies the issue. If to revalue, I need to use another stochastic scenario, it becomes a massive computing exercise. The PCs and the systems at the time weren’t capable of doing that. (Interviewee CJ)

Replios are a quicker way of doing the same calculations. Typically, replios seek to infer the sensitivity of a book of liabilities to a set of different ‘stress factors’ (e.g. a drop in the stock market index) by calculating how the value of liabilities changes in a subsample of economic scenarios. The model then attempts to optimise a portfolio of assets that replicate those sensitivities as closely as possible such that the value of the liabilities remains roughly equal to the value of the replicating portfolio in each of the stress scenarios.

The replicating portfolio models were typically used for purposes other than solvency calculations. Investment banks used replios as ‘a one-off bespoke exercise’ to identify a set of ‘static hedges’, or investment strategies that reduced the risk of a particular set of liabilities, which they then sold to insurers (Fulcher interview). Such hedges were ‘static’, because the replicating portfolio may change as economic conditions change (as implied by the concept of ‘dynamic hedging’ crucial for the Black-Scholes-Merton model). The modelling thus yields, in the words of Fulcher, a ‘static portfolio of hedges that should be robust enough to sort of last you for three years’ (Fulcher interview).

Although some considered replios a useful simple alternative to nested stochastic simulation, not everyone was convinced of their merits. According to Turnbull, for instance, the problem with replios was that ‘it was very difficult to use these portfolios of vanilla instruments [the most standard types of derivatives] to capture the complexity of how these liabilities actually worked ... the replicating portfolio wasn’t really replicating what you were actually doing’ (Turnbull interview 2). Some modellers argued, therefore, that there were ‘better technical approaches to solving the problem’ (Hibbert interview 2). Some companies developed proxy generation software, in which the computational intensity of the nested stochastic simulation was reduced by the application of regression techniques, a technique that was first applied in finance to ‘American options’ (see, e.g.: Tsitsiklis and Van Roy, 2001). For proponents of the replicating portfolio approach, however, such techniques were too complicated to be useful for practical decision making. ‘You’ve totally lost everyone who is not a mathematical expert’, interviewee CJ argued, ‘No one will understand what you’re talking about. It looks like magic’ (interviewee CJ).

The crucial point here is to note that market-consistent modelling refers to a ‘spectrum’ of models that might differ in important ways, but that nonetheless have been designed through the analogical extension of the exemplary problem solutions of modern finance theory. On one end of the spectrum there were the relatively complex but ‘precise’ economic scenario generators, and, on the other, the cruder and simpler replicating portfolio models used for risk management purposes.

## Conclusion

In conclusion, I want to stress two main points. The first is a finitist one. Even if no-arbitrage modelling was considered more objective, the extension of key exemplars from modern finance theory to insurance was not straightforward. And, according to finitism, nor can it be. The idiosyncrasies of insurance guarantees require decisions about how models are extended – decisions that are either implicit or explicit. For valuation purposes, for instance, there appeared to be two theoretically similar and mathematically equivalent, but practically different approaches to model calibration, which may have important consequences for decision making. This, then, is the micro-politics of evaluation. Decisions about how insurance liabilities are modelled may be consequential; sometimes they are made explicit, presented as a pragmatic choice, and shaped by the immediate organisational aims of the modelling exercise; more often, however, they remain implicit, constrained by implicit ‘local circumstances’ (Bloor, 1997).

This brings me to my second point, which is that the epistemic machinery underpinning the governance of life insurance changed *in conjunction with* developments in the market field more generally and the supervisory agency as ‘internal governance unit’ in particular. The limitations of traditional actuarial practices were well known and the paradigms of modern finance theory had been available for some time. Modern finance theory’s focus on ‘objective structures’, however, articulated poorly with a model of insurance in which the actuary, as the ‘custodian of surplus’ is the central epistemic authority. When the actuary’s status as such declined and pressure mounted on the newly established FSA to reform insurance supervision, however, modern finance theory appeared to articulate well

with regulatory aims. (This is not to say that modern finance theory would have never been drawn upon in actuarial science had this not happened, simply that its embrace would likely have been more limited.) This allowed those actuaries who had become familiar with modern finance theory in their travels across different professional ecologies to form a powerful alliance not only with investors (who were keen on more transparency about the economic value in the insurance business) and investment bankers (keen on selling derivative-based risk management solutions) but also with insurance supervisors in promoting the use of no-arbitrage models and risk management techniques (which are further discussed in the next chapter). Changes in the epistemic field, in other words, were intricately entangled with development in the market field and the fields adjacent to it.







## Chapter 6

# Stressing and Managing the Balance Sheet

The previous chapter dealt with valuation models. In this chapter, I focus on another set of modelling practices that came to underpin the UK's capital regulation regime and influenced insurers' capital allocation decisions: the modelling of 'risk'. In the FSA's market-consistent regime, an estimate of insurance liabilities did not suffice. To determine what level of reserves a company should maintain in order to protect itself, the FSA also required an estimate of the risk embedded in the insurance undertaking as a whole. The risk modelling practices central in this chapter are quite distinct from the valuation practices discussed in chapter 5. As David Dullaway, whom we already encountered in chapter 5, puts it, risk modelling 'is a whole separate world... You've got two questions here. You've got, how do I do the valuation, which is hard enough. And then, if I've got an economic capital world, what sort of stresses should I apply ... to the starting point of that valuation?' (Dullaway interview). In comparing the two worlds, actuaries tend to understand the world of valuation as revolving more around 'hard facts' that are 'mathematically correct' and 'almost provable'; the world of risk analysis, in contrast, is seen as involving limited data that require interpretation based on 'expert judgment and opinions' at least as much as concrete evidence (Sharp interview).

It may sound counterintuitive to state that risk analysis emerged only as a key mode of governance in the early 2000s. After all, has insurance not always revolved around the analysis and management of risk? Indeed, to some extent, this is true. Since the 19<sup>th</sup> century, insurers were well aware that insuring the life of a single individual could be risky business. The solution to such risk was to make sure that insurance was written on a large enough pool of 'independent' lives such that the risk of a single individual dying much sooner than expected could be diversified away. In chapter 3, however, we saw the emergence of another type of 'risk' that was non-diversifiable: financial market risk. In contrast to the 'diversifiable risk', the

management of ‘non-diversifiable’ risk was perceived to require explicit modelling and quantification. This, in a nutshell, is what is meant here with risk analysis and management: the modelling and quantification of ‘non-diversifiable’ risk (analysis) and the control and selection of risks, either by passing them on to third parties through market transactions or by retaining them on your balance sheet and ‘controlling’ them (management).

The introduction of risk analysis and management is intricately entangled with the introduction of market-consistent valuation. Both sets of practices contributed to the explication of ‘value’ and ‘risk’, albeit in different ways. This explication, I argue, marked a shift in the relations among stakeholders in the life insurance business. In conventional life insurance arrangements, for instance, shareholders relied on actuaries to ensure a steady stream of dividends. In today’s insurance arrangements, however, actuaries produce representations of economic value and risk; the decision about whether the promise of future profit is ‘credible’ is left to shareholders. The new epistemic machinery emphasised the optimisation of capital usage, and the proliferation of novel investment strategies to manage risk capital, with concomitant changes in the structure of the insurance market.

In this chapter, I examine the evolution of risk analysis and management in life insurance, a development that was strongly influenced by the regulatory changes in the early 2000s with the introduction of the Individual Capital Adequacy Standards (ICAS) and the Realistic Balance Sheet. First, I describe the epistemic problem of quantifying non-diversifiable risk. I then move on to discuss the evolution of risk analysis in the context of life insurance, before describing how insurers developed the risk models that allowed them to comply with the ICAS. Finally, I argue that risk models (in conjunction with the market-consistent models discussed in the previous chapter) reshaped the market field of life insurance by further reducing the epistemic authority of actuaries and by casting the optimisation of capital as a primary organisational objective.

## Risk Modelling as the Construction of Fictional Expectations

To get a sense of the epistemic dimensions of risk modelling, it is useful to compare it with the valuation modelling discussed in the previous chapter. One important difference is how the risk and valuation models engage with the future. The market-consistent valuation models discussed in the previous chapter infer the value of liabilities by considering how future variation in underlying cash flows can be neutralised (or ‘hedged’) by a portfolio of instruments whose characteristics mirror those of the liability. As discussed in the previous chapter, insurers started using risk-neutral economic scenario generators to do these calculations, which some of my interviewees suggested should be ‘provable’ in principle.<sup>26</sup> The value of insurance liabilities, however, also depends on parameters that cannot readily be ‘hedged’ with market instruments, the non-diversifiable dimension of risk. In market-consistent valuations, these parameters are typically accounted for with a ‘best-estimate’ expectation. Such estimations or forecasts have no ‘objective’ referent but are made drawing on a variety of resources. The models in this chapter similarly seek to forecast or estimate a variety of risks; they focus, however, not on the central expectation (the ‘best estimate’), but on a worst-case scenario with a pre-specified probability. In the case of insurance, risk modellers are typically interested in estimating what a ‘1-in-200 one-year event’ looks like.

Thus, while market-consistent models seek to model how future variation in the underlying cash flows of liabilities may best be insulated in the present, risk models seek to ascribe ‘real-world’ probabilities to a range of different outcomes. Each type of modelling comes with its own peculiar challenge. In the case of market-consistent modelling, the challenge is to construct a model that can reproduce market-observed prices, which is complicated by the fact that consistency in market observed prices may be less than ideal. In the case of risk modelling, however, the challenge is that the future is ‘fundamentally uncertain’ (Beckert, 1996, 2016). In a highly controlled setting (a ‘closed system’), uncertainty may be expressed in

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<sup>26</sup> What is meant here is that in a market-consistent model it should be possible, in theory, to retrieve the variables to which the model is calibrated as output from the model. Since the input variables are ‘market observables’, two ‘fully’ market-consistent models should produce very similar output.

quantitative terms as ‘risk’. When tossing a coin, we can be fairly sure that the likelihood of the toss returning heads or tails approximates half. The risk of losing £1 in a £1 bet is 0.5. If there are elements of the setting that are not controlled, however, certainty over whether the estimated distribution of likely outcomes decreases. In the above example, for instance, how can we be certain that the *specific* coin being tossed exhibits some key properties that we associate with a coin – namely, that it will land heads roughly half the times you flip it? How can we be sure that the coin has not somehow been damaged or tampered with to skew its propensity to land heads in one direction or the other? Because such fundamental or ‘Knightian’ uncertainty in practical applications of risk analysis always remains, risk modelling revolves around the construction of ‘expectations’ that guide present action more so than it is about ‘knowing’ the future (Beckert, 2016, chapter 3).

Expectations, Beckert (2016) argues, whether derived from economic theory or through induction, are ‘fictional’. By this, he means that economic expectations such as risk forecasts ‘create a reality of their own by making assertions that go beyond the reporting of empirical facts’ (p. 61). They are constructions of the future that exist in today’s reality; they are, in other words, ‘present futures’, partially grounded in imagination, partially grounded in ‘empirical fact’, that are accepted by relevant actors as plausible. The construction of such ‘fictional expectations’ and actors’ willingness to act upon them *as if* they were true facilitates action in the face of fundamental uncertainty.

In some cases, the ‘fictional’ character of risk modelling becomes quite obvious. Take for instance longevity risk, or the risk that future improvements in mortality deviate from actuaries’ ‘best-estimate’ of mortality improvements.<sup>27</sup> This is, for instance, how Andrew Smith described the challenges in modelling longevity risk:

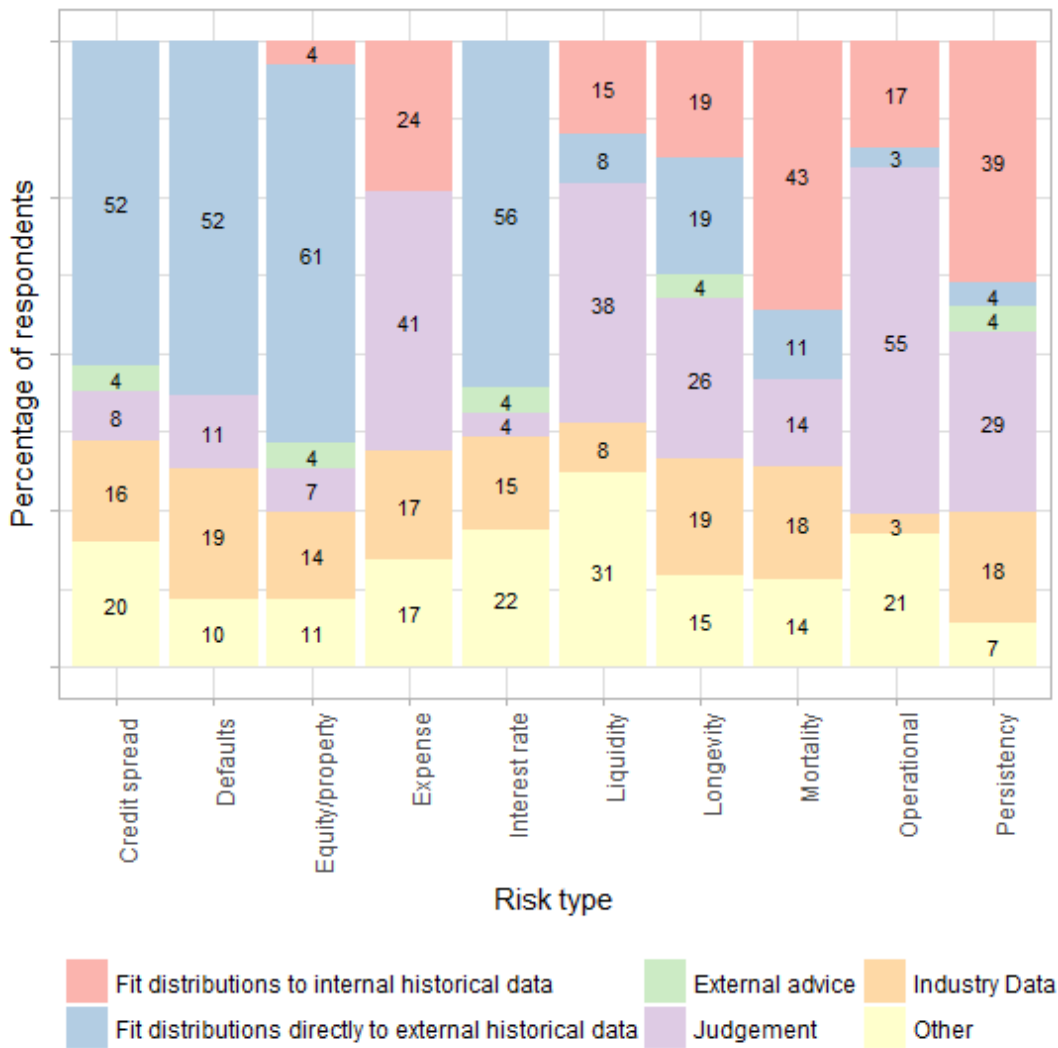
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<sup>27</sup> Longevity risk is not to be confused with mortality risk. While the latter refers to uncertainty about the timing of individual mortality – a form of uncertainty that can be reduced in the aggregate by ‘pooling’ together multiple lives – longevity risk refers to uncertainty about improvements in the average mortality of an entire population. Thus, in contrast to mortality risk, longevity risk is non-diversifiable.

The thing about longevity is there are so many different approaches, and ... there's a huge amount of really deep uncertainty. So there's not just the difficulty of describing the historic data statistically. It's an immensely complex data set... [W]hen you're forecasting future longevity of people who are retiring now, you're forecasting the quality of care that they are gonna get... the amount of exercise they are going to get, how good their diet is going to be. And all of these things are difficult socio-economic things to forecast...

By itself, archival-statistical analysis of mortality data is already quite challenging, as Smith argues, but the modelling of longevity risk is further complicated by the need to consider the relevance of such knowledge for the future, a future that is fundamentally open-ended. Risk modelling, in other words, is as much about storytelling as it is about statistical analysis (cf. Leins, 2018). Indeed, modellers sometimes explicitly recognise the role of 'stories' in justifying the choice for a particular scenario as a plausible 1-in-200 scenario. 'So what all this means is, because a risk manager could tell you a story, if they believe it to be true, about a 1-in-200 year [event]: "ah well, that old data isn't really valid anymore, because that was before electronic trading started or the central banks gained independence"' (Sharp interview).

As with fiction, 'good' risk modelling induces a suspension of disbelief, albeit perhaps in a slightly different way. In the case of literary fiction, the reader may forget that the imaginary elements are indeed imaginary, partly so because it is a convention to do so. The fact that literary texts are fictional, Beckert argues, does not mean that 'there is no correspondence between fictional texts and reality; to the contrary, the assertions of fictional texts are often credible precisely because they are or could very well be true because they are coherent, and because they are closely interwoven with nonfictional information' (Beckert, 2016, p. 65). 'In the case of fictional expectations in the economy', however, 'the suspension of disbelief is based on the conviction that the imaginary of the future will become a future present, or is at least somewhat likely to do so' (Beckert, 2016, p. 68). Relevant actors need not mistake risk models for reality, but at least believe that the range of predicted outcomes somewhat plausibly represent the 'true' range of future potential outcomes. The same, one could argue, goes for risk modelling: actors may be willing to suspend



**Figure 6.1** Insurers’ self-reported use of different stress testing methods. The figure displays the percentage of respondents that listed each of several methods as ‘most important’ for calibrating the 1-in-200 stress for a range of different risks. Note, in particular, the broad diversity across the different risk types. The figure is a reproduction of a similar figure featured in the KPMG report on their 2014 annual technical practices survey.

their disbelief in the possibility of predicting the future if the expectations appear plausible, coherent and draw at least partially on available statistical knowledge.

Actors may draw upon various resources to make their models ‘credible’.<sup>28</sup> In fact, figure 6.1 makes clear that modellers in insurance may draw upon a wide range

<sup>28</sup> It is possible here to draw a parallel between ‘facts’ and ‘present futures’. As MacKenzie (2009) argues with respect to the realm of fact, what sociologists are interested in is not to investigate whether facts are really true, but rather what conditions allow a given fact to be accepted as such (pp.



of different resources. The figure is derived from the KPMG annual technical practices survey in 2014 and depicts what insurers' most important resources were for calibrating the different stresses. The survey reports not only large differences among different types of risk, as one might expect, but also a large variation in what insurers reported as their most important source for the same risk.

To see how risk models are produced, it is useful to distinguish between two main resources, each of which can be deployed in-house or is provided by an external adviser.<sup>29</sup> The first resource is 'archival-statistical' knowledge (Collier, 2008). Although statistical analysis may appear rather straightforward at first sight, several major difficulties appear when looked at more closely. Especially in the long-term context of life insurance, the absence of data is often problematic. Take equity risk, for instance. Stock markets have changed quite significantly throughout history. One of the major changes was the introduction of limited liability, which, in the UK, only took place in 1856 (Johnson, 2010, chapter 5). More recently, the technological transformations of financial markets with, for example, the introduction of telecommunications and the increased financial market volatility since the 1970s are considered as evidence of fundamental changes in the operation of financial markets. Hence, 'most people calibrate their models of something starting in 1975 ... that's when MSCI [the Morgan Stanley Capital Indices] started producing their index data' (Sharp interview).

Deriving a 1-in-200 estimation from 20 years of data presents statistical difficulties:

if you look at your 25 years of data and it did contain a 1-in-200 event, and you assume [that from] those 25 years ... you can derive what the overall distribution of something is, and there was a 1-in-200 in the last 25 years, then you're going to think that that 1-in-200 was really a 1-in-25... I mean, to really know what a 1-in-200

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8-10). Similarly, we may say that the present purpose is not to assess the plausibility or credibility of present futures, but rather to investigate the conditions that allow present futures to be accepted as 'future presents', or as plausible and credible depictions of the future.

<sup>29</sup> The two main types discussed here do not cover all possibilities. Some insurers, for instance, may decide to calibrate a stress to 'market observables'. As discussed in the previous chapter, no-arbitrage models may be used to 'back out' a 'market implied volatility' measure, which can then be used to determine what a 1-in-200 scenario would look like. This approach can only be used for market risks.

was ... you probably need more than 200 years of data - particularly to get at the tails. There is mathematics that addresses this issue but the fundamental issue remains. (Sharp interview)

In order to determine the magnitude of a 1-in-200 one-year event in a statistically meaningful way, ideally you would need at least 200 years' worth of data. But not just any data – data that is derived from a relatively stable context. For risk modelling purposes, archival-statistical knowledge is considered useful but not without its problems.

The second resource, which is extensively used, is 'expert judgment'. This type of resource draws most explicitly on imagination and storytelling (cf. Wansleben, 2014) and, with the increased centrality of risk modelling in actuarial work, has become an increasingly important object of debate within the actuarial profession (Ashcroft *et al.*, 2016; Tredger *et al.*, 2016). 'Expert judgment' is often understood as a well-informed guess, the reliability of which is potentially harmed by 'cognitive bias'. Suggestions for improving the 'reliability' of expert judgment hence posit that the guessing process – envisioning what might happen and how likely some things are to happen – should be structured such that bias is reduced to a bare minimum (Tredger *et al.*, 2016). This leads to the development of an accepted vocabulary of justification that indicates how modelling choices may be justified (cf. Mills, 1940). Expert judgment thus partly revolves around the appropriate use of a vocabulary that may be drawn upon to justify modelling assumptions.

The appropriate vocabulary is influenced by supervisory challenges of the narratives and assumptions underpinning 'stress scenarios'. An example of this can be found in the FSA's report *ICAS: One Year On*, in which it reflected on the review of the returns of the first twelve companies it scrutinised. Take for instance the risk of a catastrophic event occurring, whether 'natural' or 'man-made', with grave consequences for overall mortality. The report noted that:

A number of firms have selected a catastrophe scenario which involves the spread of a new disease or a repeat of a previous pandemic such as Spanish flu. Some of these firms have then assumed that new drugs would be created in time to treat newly emerging diseases and that international crisis management plans would be fully effective in preventing the spread. We have asked

these firms to provide further detail on their reasoning for these assumptions. (FSA, 2005, pp. 29–30)

How likely is a catastrophe mortality event like the Spanish flu today? And will modern medicine be quick enough to develop an antiviral and stop the flu from spreading? Since neither of these ‘scenarios’ can be confirmed or disconfirmed, supervisors may push modellers to justify their assumptions, but cannot ‘validate’ or ‘invalidate’ model assumptions.

## The Evolution of Stress-Testing and Risk Analysis

The history of non-diversifiable risk modelling in the context of life insurance predates the implementation of the ICAS regime. As discussed in chapter 3, financial risk became an object of actuarial interest already in the 1970s and 80s. Since then, actuaries typically used the Wilkie model for stochastic simulation of financial risk. In the 1990s, however, actuaries also began deploying statistical techniques to examine other ‘risk factors’, most notably ‘longevity risk’, or the risk that actually experienced mortality structurally diverged from predictions (Cairns, Blake and Dowd, 2006). Trends in mortality had always been a topic of actuarial interest. After all, to value an insurance liability one needed to come up with an estimate of future mortality. Early investigations of mortality trends, however, focused primarily on interpreting large mortality data sets and did not seek explicitly to quantify the likelihood of actual mortality experience to diverge from predictions in the future. This changed in the 2000s when actuaries increasingly started modelling long-term mortality trends (as opposed to individual mortality) *stochastically*, allowing them to assess the likelihood of future mortality to diverge from the predicted trend.

Innovations in mortality modelling initially took place outside the actuarial context. Most notable was the Lee-Carter model, a model that was developed, not by actuaries, but by the UCL Berkeley demography professor Ronald Lee and the sociology professor, Lawrence Carter, from the University of Oregon. In their seminal paper, Lee and Carter noted that a simple extrapolation of average twentieth century mortality improvements of the US population would lead one to conclude that life expectancy would rise to 100 by 2065, a development, they noted, that

would ‘come as a nasty surprise to the Social Security Administration’ (Lee and Carter, 1992). By modelling US mortality using state-of-the-art techniques of extrapolation, Lee and Carter examined the likelihood of this event occurring. Benefitting from recent developments in time series analysis, they forecasted mortality by projecting forward life tables with a model that is ‘based firmly on persistent long-term historical patterns and trends’ and ‘provides probabilistic confidence regions for its forecasts’ (Lee and Carter, 1992). They concluded that expected life expectancy in 2065 would be 86.05, not 100. The analysis, they suggested, ‘demonstrates that for life expectancy to rise to such a high value as 100 by 2065 would require a radical break in historical trends’ (Lee and Carter, 1992). The crucial innovation of the Lee-Carter model was to include ‘confidence regions’, which made possible the statistical analysis of the likelihood of extreme events.

The uptake of quantitative risk models such as the Lee-Carter model by actuaries and life insurers was strongly influenced by regulatory change. As discussed in chapter 3, actuaries started developing quantitative risk assessment techniques for financial market risk in the 1970s and 80s drawing on risk theory, but their use had remained rather limited. Paul Fulcher, who was an actuary at Friends Provident at the time, remembers for instance that such modelling ‘wasn’t really driving a huge amount of decisions ... the modelling seemed a little bit for the sake of it’ (Fulcher interview). By the 1980s, however, there was significant financial market volatility and regulators became increasingly interested in quantifying the financial risks embedded in insurers’ liabilities. In 1985, for instance, the Government Actuary’s Department introduced the ‘resilience test’ for unit-linked business, which ‘required actuaries to consider the adequacy of their reserves in the context of immediate falls in asset values of 25% in equities ... and also the changes in values equivalent to a rise, or a fall, of 3% in the yields on gilt-edged and other fixed-interest stock’ (Fine *et al.*, 1988). The resilience reserve test is now regarded as a ‘first generation stress test’ (interviewee BC), which anticipated quantitative risk management as the pivot of risk-based capital requirements. From today’s perspective, however, the test seemed rather ‘crude’ (interviewee BC).

Nonetheless, the implementation of the resilience reserve test raised some difficult questions, some of which anticipated later debates on the ‘procyclicality’ of risk-based capital regulation (the tendency of risk-based capital regulations to exacerbate downward market trends by forcing asset sales in times of stress). Many actuaries understood equity prices to follow a cyclical pattern. Asking firms to maintain reserves against a 25% drop in equities while the market was already in a downswing seemed rather cumbersome, potentially forcing insurers to sell shares in market downturns thereby worsening them. In his Presidential Address, Roger Corley posed the problem as follows: ‘if the market shifts in such a way as to remove 90% of a particular life office’s mismatching reserve, and there is no reason to expect an early reversal, what mismatching reserve should that office then be required to maintain?’ (Corley, 1989, p. 21).

By the late 1990s, the Government Actuary’s Department considered how to make the resilience test dependent on current market conditions. Its proposals were implemented by the FSA, which took over full control of insurance supervision in 2001. On September 10, 2001 the FSA issued a letter in which it required insurers to perform a resilience reserve test for at least a base scenario of a 25% decline in equity values subject to the constraint that equity prices divided by the earnings of the underlying stock (the ‘P/E ratio’) should be no smaller than 75% of the inverse long-term gilt yield (Hewitson, 2001). The severity of the scenario, in other words, was capped by the fundamental revenue stream of stocks. Even so, the FSA decided temporarily to revoke the resilience reserve test only two weeks after it had initially sent out its new resilience requirements. On September 11, the terrorist attack on the World Trade Center caused significant stock market distress. To prevent ‘technical selling’ of equity – equity sales that are induced by deteriorating regulatory capital rather than an ‘economic’ rationale – the FSA decided that the resilience reserve test, even in its amended version, would need to be revoked (Roberts, 2001). Even if from today’s perspective the resilience reserve test seems a rather embryonic form of risk-

based capital, it already indicated potential difficulties of risk-based capital regulation more generally.<sup>30</sup>

Risk-based capital was further developed with the introduction of the ICAS, for which each firm had to perform its own Individual Capital Assessment (ICA). As described in the previous chapter, the introduction of ICAS was driven by a confluence of the collapse of Equitable Life, the initiation of regulatory change on the European level, and the emergence of the FSA as an integrated supervisor for both banking and insurance. Market-consistent valuation, as discussed in the previous chapter, was one aspect of the envisioned regime. Firms' ICAs would be another major component. The FSA's stated aim was to make capital regulation more 'transparent' by making firms responsible for performing their own risk assessment and to determine their own capital requirements, which would then be reviewed by supervisors (FSA, 2002a).

The ICA was heavily influenced by developments elsewhere, such as innovations in bank capital regulation, and the European Commission's project to overhaul European insurance capital regulation (see chapter 7). An influential report commissioned by the European Commission and composed by KPMG to make concrete proposals for the new European insurance capital regime borrowed heavily from the Basel accords for banking (the report will be discussed in more detail in the next chapter). Similarly, the FSA's temporary domestic regime came to reflect broader trends in the regulation of capital: 1) capital requirements were based on insurers internal risk assessment, which would incentivise enhanced risk control; 2) whereas insurers had previously only considered market risk, they were now expected to perform quantitative analysis of other risks too, either through scenario and stress testing, or through stochastic analysis; and 3) value-at-risk (VaR), a measure already widely used in banking, became the standard way to measure 'risk'.

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<sup>30</sup> Sometime later, it would embrace a slightly different approach to make the test contingent on current market conditions. The FSA still required insurers to test the financial condition against a scenario of between 25% and 10%, but the precise level was not contingent on price/earning ratios, but average historical price levels.

The idiosyncrasies of insurance meant there were limits to the extent to which regulatory templates used elsewhere could be imposed on insurance capital. The forecast horizon, for instance, is markedly different between insurance and banking. The Basel regime requires banks to calculate the VaR of the 99<sup>th</sup> percentile of ten-day scenarios.<sup>31</sup> Insurers, however, are required to estimate how much capital they need to remain solvent in a one-year period with an estimated 99.5% probability, or, in other words, all but the worst of 200 one-year scenarios. The choice of time horizon and stress severity is not a straightforward one. One justification for the one-year time horizon is based on the claim that one year is roughly the time needed to completely ‘de-risk’ a portfolio of insurance liabilities. Others argue that a one-year measure is a compromise between the long-term nature of life insurance while allowing analysis to be grounded more firmly in statistical analysis compared with a more distant ‘run-off’ measure. Some interviewees, moreover, have suggested that the particular confidence level of 99.5% was selected because it produced acceptable levels of regulatory capital. Regardless, as discussed in more detail below, the one-year time horizon limited the extent to which insurers’ risk models could be rooted in statistical analysis of historical data.

Another difference is that insurers calculate a broader range of risks. In addition to market risk, insurers evaluate insurance-specific risks such as mortality, longevity, morbidity and lapse risk. Indeed, as the KPMG survey indicates, most insurers allocate nearly as much capital to insurance-specific risks as they do to financial risk (KPMG 2014: 43). Not only are insurance-specific risks difficult to calculate, but so are the ‘second order effects’ like the correlation between risk factors, or the ‘diversification’ effects (interviewee BC). As different risks may be ‘imperfectly correlated’ (i.e. if one stress occurs the chance of another stress occurring is less than 1), total VaR will be less than the sum of VaR for individual risk factors. The impact of diversification is not trivial. In an article in the *British Actuarial Journal*, Andrew Smith, the consulting actuary Richard Shaw, and the CEO of Blackrock Life Grigory Spivak, estimated, for instance, that diversification benefits may ‘amount to anything in the region of 25-50% of an insurance

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<sup>31</sup> This may seem quite low, but it is only one of several components of banks’ capital requirements.

company's undiversified total economic capital' (Shaw, Smith and Spivak, 2012, p. 602).

The way in which insurers account for diversification benefits has gradually evolved too. Under the ICAS regime, insurers typically evaluated sixteen different risks, diversification among which was then taken into account with a sixteen-by-sixteen 'correlation matrix'. The dependency among risk factors was modelled as a simple 'correlation' relation. The advantage of this approach was that no explicit estimation of the probability distribution of a risk factor was needed; a simple estimation of the 1-in-200 stress sufficed. The correlation matrix approach, however, is perceived to have some important weaknesses: it does not allow, for instance, for 'heavier dependency in the tail', it does not 'capture non-linearities', and, where data on correlation is sparse, relies heavily on 'expert opinion' (Shaw *et al.*, 2012, pp. 630–631)

An alternative, more 'sophisticated' approach is to use a 'copula model', whereby the probability distributions of different risk factors are jointly modelled to produce a single model for all risk factors combined (a 'multivariate joint distribution'). In the early 2000s, copula modelling was a relatively new phenomenon in actuarial science. The first actuarial application of copula models was the valuation of joint annuities – annuities that pay a regular stream of income until both partners die. Traditionally, actuaries modelled the deaths of the partners as independent events. Various empirical investigations had shown, however, that 'survival of pairs are not independent events' (Frees, Carriere and Valdez, 1996, p. 230). If one partner died the likelihood of the other partner dying in subsequent years increased. In collaboration with Jed Frees and his doctoral student Emiliano Valdez from the University of Wisconsin, the Canadian research actuary Jacques Carriere sought to model the 'joint survivorship of two annuitants' as a single event by drawing on copula theory (Frees *et al.*, 1996; MacKenzie and Spears, 2014b). Their model suggested that the price of a joint annuity could be three to five percent lower than if joint survivorship had been modelled as depending on two independent events (Frees and Valdez, 1998, p. 6).



In subsequent years, actuaries increasingly started drawing on copula theory for claims modelling, predominantly so for pricing purposes in the context of general insurance (Genest, Gendron and Bourdeau-Brien, 2009).<sup>32</sup> By the mid-2000s, copula theory also increasingly started informing actuarial modelling of ‘diversification’ effects across different risk categories. The simplest member of the copula family of models is the Gaussian copula, which allows the modeller to join up a series of Gaussian or normal distributions. However, while relatively simple, the Gaussian copula assumes that even with non-zero correlation two variables are independent when moving far enough into the tails. ‘I would worry’, John Hibbert said, about ‘the dependency in the stress most, not the kind of average statistical correlation’. ‘You know what happens when you get a really big fall in equity markets? Well, interest rates probably move down quite a long way. That’s what we’ve seen during periods of stress’ (Hibbert interview 2). A Gaussian copula model does not allow for such tail dependency.

An alternative to the Gaussian copula is the ‘t-copula’. T-copula models do allow for tail dependence and are therefore seen as more ‘realistic’. T-copulas, however, have their own limitations too. The strength of tail dependence is determined by a single parameter: the ‘degrees of freedom’ parameter. As a consequence, the strength of tail dependence is the same for all combinations of risk factors that are included in the copula model. Although this limitation might be overcome by using a generalisation of the standard t-copula, the ‘individuated t-copula’, doing so would lead to another layer of complexity in the risk-model itself. The choice of modelling strategy, in other words, ultimately depends on how actuaries decide to make a trade-off between ‘realistic’ representation of risk diversification and opacity of their model for non-mathematical experts.

Copula models cannot readily be solved analytically and require simulation. They are computationally demanding and were, therefore, throughout the 2000s,

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<sup>32</sup> As MacKenzie and Spears (2014b) show, the copula modelling techniques deployed by Frees, Valdez and Carriere migrated to the context of finance too, where they were used to model the dependency of default on a group of assets such as corporate loans or bonds, and later also mortgages (see also: Donnelly and Embrechts, 2010).

rarely used for regulatory capital purposes. By the early 2010s, however, some insurers (particularly the larger ones like AVIVA and Legal & General) started using copula models, even if copulas were disliked in finance (particularly the Gaussian copula) in the wake of the financial crisis (Donnelly and Embrechts, 2010; MacKenzie and Spears, 2014b). In KPMG's 2014 technical practices survey, for instance, 8 out of 31 firms reported to use a copula model; two of which said to use t-copulas rather than Gaussian ones. The bulk of the firms, however, stuck with correlation matrices, either using the 16-by-16 matrix previously popular or adopting a layered approach where risks would be grouped together. Thus, with the increased complexity of risk modelling, greater divergence in risk modelling practice across firms took place, a phenomenon that seems to have been correlated, in particular, with firm size.

In sum, insurers' risk analysis methods and techniques changed significantly over the course of the 2000s and 2010s. In the words of a former regulator, regulatory stress testing moved from being a 'straightforward linear thing' towards becoming a form of 'scenario testing', where 'you can look at ... if the world moves from what it is to this scenario ... this will have this family of consequences for my balance sheet, and let's take account of all of them' (interviewee BC). The increased 'realism' of risk models, however, did not come without a cost. As noted above, the complexity of copula models, for instance, makes them rather computationally demanding and their design and operation requires very specific expertise.

## Risk Modelling as a Collective Activity

A comparison between how insurers' valuation models and risk models were developed yields an interesting puzzle. Most insurers outsourced their market-consistent modelling to firms like Barrie & Hibbert and Deloitte. Most of the risk modelling, however, was done in-house. They may have sought advice from external sources, but the overall specification of the model and the calibration of some of the more important 'stress factors' was typically done by companies' own actuaries.

The difference between the distribution of valuation and risk modelling labour may simply be explained by the fact that regulators wanted firms to perform their

own risk assessment. An influential review of insurance failures (including a private data set on ‘near failures’) performed by the Conference of Insurance Supervisors under auspices of Paul Sharma, Head of the FSA’s Prudential Risk Department, had concluded that most failures were not due to weak capital requirements but rather because of poor risk analysis and management. The report, which was commissioned by the European Commission early on in the Solvency II process (discussed in chapter 7) suggested there was a need for supervisory tools to ‘improve focus on risk management and internal control’ (Conference of Insurance Supervisory Services of the Member States of the European Union, 2002). Indeed, an important justification for the ICAS was that it would incentivise insurers to improve their risk knowledge.

Another explanation might be that firms wanted to control their own capital models. Prior to ICAS, some insurers (especially the larger ones) had some basic risk analysis in place to inform decision-making. When risk models started determining capital requirements, the incentive for insurers to do their own analysis strengthened. Although modelling firms did offer risk capital models, their uptake remained rather limited. Indeed, some suspected it was about an issue of control:

I don't think an insurance company wants an externally supplied capital model stress, because if they just use the quarterly calibration from XYZ Financial Modellers then their capital would be driven by XYZ Financial Modellers’s calibration. And people want to own – each insurance company wants to own their calibration ... they want to be in control of the answer coming out. The stress calibration can directly drive what their SCR [solvency capital ratio] is going to be. If they delegate the calibration of the model to XYZ Financial Modellers then there's a chance that XYZ Financial Modellers says we've done some more research , or some new data has emerged, and it’s making changes to the model, so that over time the capital goes like that [interviewee draws an upward sloping curve in the air]. Then companies would go: “What have we done? How can our capital be higher than it was twelve months ago, just because XYZ Financial Modellers has decided the world's become riskier". This is a simplistic statement because the modellers should discuss changes with their clients and the clients can always amend parameters in the calibration but the underlying point remains - an insurer wants to own the calibration of the risk model. (Sharp interview)

If the risk capital model is used to constrain an insurer's actions, this may lead to an incentive for the insurer to model risks in ways that are least constraining. Other interviewees recognised this point too. According to David Dullaway, for instance, the tight coupling of capital requirements with firms' own internal risk assessment constituted a tension that may be difficult to resolve:

[B]efore the realistic balance sheet, there were some companies that did economic capital calculations... But when [the calculations] were their own capital calculations and they didn't affect the capital you had to hold for the regulator, you tended to be very honest with yourself, because after all, *you chose* to do the calculation. ... As soon as that model becomes your regulatory model, and you have to disclose it to the outside world, you suddenly have an incentive to get the numbers as low as possible. So, in some ways, making the regulatory model and the economic capital model the same thing, changed the way that companies thought about their economic capital models, from being a useful tool to being a number you wanted to minimise. (Dullaway interview)

Regulatory capital is an important aspect of strategic decision-making and if regulatory capital depends on firms' internal risk assessment, then firms are likely to want to retain control over that assessment to avoid sudden increases in regulatory capital. One could argue, of course, that the same goes for valuation: if the amount of regulatory capital depends on the value of firms' liabilities, then firms are more likely to want to retain control over that model. An important difference, however, is that valuation models, as noted at the start of this chapter, are considered relatively 'objective', while risk capital models are considered more 'subjective': the construction of the latter, in other words, is seen as less constrained. Although market-consistent modelling still requires decisions to be made, actors understand it as more narrowly constrained than risk modelling, which, in turn, contributes to making them so.

Even though there was little epistemic consensus on *how* a 1-in-200 stress scenario should be construed, modellers' actions were far from unconstrained. The constraints, however, were not imposed *directly* by the regulator. Regulators, as one supervisor remembers, 'hadn't really told firms in very much terms how to calculate their individual capital requirement' (interviewee BB). Nevertheless, regulators and

supervisors were well aware of the tension between insurers' interest in appropriate risk knowledge and their desire for moderate capital requirements and hence deployed several strategies to prevent firms from lowballing their risk estimations.

One strategy was to challenge insurers to justify their choices. In reviewing insurers' capital models, for instance, supervisors proclaimed to focus 'upon whether the firm has used an appropriate approach to calculations and involved the people in the business in the best position to apply judgements. The more *credible* the approach, the more we can rely on the answer' (FSA, 2005, p. 12, emphasis added). In response to the need for 'credible' risk modelling practices, the Institute and Faculty of Actuaries set up working parties like the Benchmarking Stochastic Models working party and the Stress Test working party, to interrogate insurers' practices. Similar to valuation modelling, regulators defined the output that they wanted insurers to produce but delegated the development of a vocabulary to justify particular modelling choices to the actuarial profession.<sup>33</sup>

In lieu of a well-established vocabulary of justification (simply because risk modelling was relatively new), firms and supervisors deployed other means to determine their stresses too. Firms would observe what other firms were doing (White, 1981). They compared, for instance, the severity of the 1-in-200 stresses with one another. Such observations were rarely direct but were mediated by actuarial consultants. 'Insurers, via consultancy, talk to other insurers' (Smith interview). Consultants would relay information they obtained through their advisory work for one company to the risk modellers of another. Dullaway, remembers for instance 'having a database of all the stresses' he had seen at his clients:

So when somebody came along and said: what do you think this stress should be, I could say: 'well, here's analysis we've done. But also, I think most of your competitors are in a range of this to this.' So you know that would be equally important for somebody setting their stress because they didn't want to be too far out of the range.  
(Dullaway interview)

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<sup>33</sup> The FSA summed up its approach quite nicely in an early review of the regime: 'We keep an open mind on the majority of calculation approaches used by firms, placing the onus on them to satisfy us that their particular approach is appropriate to their individual circumstances' (FSA, 2005, p. 4).

Consultancies, moreover, conducted surveys, such as the KPMG technical practices survey, that showed what ‘the market’ was doing. Consequentially, some of my interviewees noted, ‘some of the [modelling] assumptions I guess were based on sort of almost a market consensus at the time rather than necessarily a lot of hard evidence (Dumbreck interview).

Market consensus did not in all cases emerge spontaneously from the interactions among firms’ actuaries mediated by consultants, but was sometimes facilitated by supervisory ‘benchmarking’. Certainly at the outset, modelling practices tended to diverge quite significantly. The FSA therefore sought to develop internal benchmarks that it used to compare the stringency of firms’ internal models. Benchmarking, however, only partially solved the FSA’s epistemic problem of assessing the adequacy of stress calibrations. Different firms tend to have different ‘risk profiles’. Annuity providers, for instance, tend to invest in different assets than insurers writing primarily term assurance, which should, in theory, result in a different calibration of the 1-in-200 credit default stress. Similarly, a 1-in-200 longevity stress calibration for an annuity provider underwriting primarily to people working in higher education is likely to be different from a 1-in-200 longevity stress for an annuity provider underwriting primarily factory personnel. An overreliance on benchmarks could mean that firms were not sufficiently scrutinising the risks themselves. Nevertheless, benchmarks were an important supervisory tool. The FSA gradually ‘took a stronger line on assumptions that they didn’t think were fully justifiable, and also maybe a stronger line on consistency between companies’ (Dumbreck interview).

The development of insurers’ risk modelling practices was thus a fundamentally social process, in which the relations and tensions among relevant actors influenced the stringency of stress scenarios (cf. Thiemann and Lepoutre, 2017). Some of my interviewees described this social process in combative terms, even though it may not necessarily have involved manifest antagonism and hostilities. One interviewee suggested for instance that ‘there is actually a bit of a battle between companies and regulators because regulators clearly want the answer to be right in the round; companies want to say: “where can I push it lower?”’

(Dullaway interview). Consequentially, key decisions may be made during an extended approval process that takes the form more of a ‘technical debate’ between the regulator and regulated (Thiemann, 2018). This is, for instance, how a former chief actuary of one of the largest UK insurers experienced the ICAS approval process:

I must have spent probably six months, you know, week by week negotiating with the regulators. We went through each element. They thought, no we disagree with this, this and this. And we think you should hold extra capital. And it was a genuine, not so much a negotiation, but a sort of a technical debate. And in the end, some things they agreed with us, some things we agreed with them. But you came to an agreed position on things, or even if it was just a gentlemen's agreement to disagree. You know, it was a proper dialogue around risk and what the company's view was, what the regulator's view was and what the balance in capital was... And I remember when we got our final ICG [individual capital guidance] I came back and told our executive committee, and there was a round of applause at the end of this six months of debate. (Belsham interview)

Supervisors may perceive a firm's model as too weak, while an insurer thinks it appropriate. A crucial tool to resolve such disputes was the ‘individual capital guidance’. If supervisors disagreed with insurers' modelling, it could simply impose ‘capital add-ons’. The FSA made extensive use of this tool: of the first ten companies it reviewed, the individual capital guidance was between 110% and 170% of firms' own estimations of capital requirements (Bruce, 2006, p. 28). Although firm-specific information about the individual capital guidance remained private, investment analysts wanted to know more about their capital requirements (Bruce, 2006). As a result, firms were keen to reduce capital add-ons by bringing their risk models in line with supervisory standards.

## Managing the Balance Sheet

The bedding down of the new risk models had profound consequences for the management of life insurance. Throughout the 2000s, ‘risk’ gradually became a central object of management in insurance companies, as manifested by a proliferation of risk functions, increased use of derivatives to manage financial risk,

and an expansion of the actuarial education syllabus to include risk management. Although, as Van der Graaf's (2018) ethnographic study of risk management in a continental European insurer shows, risk managers rarely may see the 'precise' risk calculations as 'true' representations of risk, risk nevertheless became an increasingly important object in shaping the field of life insurance.

The emergence of 'risk' reshaped the relations between insurers and their shareholders. Andrew Chamberlain (formerly at the GAD) described such changes in the following terms:

In the old days, when I started ... a lot of the funds were with-profit funds, and the profits thrown off to shareholders from a with-profits fund properly run were fairly consistent. So you bought life insurance companies for steady income that would grow at the time. And people didn't really understand anything about what went on underneath the bonnet of the car. They just knew that the car drove off at a fairly steady pace in the right direction. And that's why people would invest in – maybe it's commercial, well not so much commercial, because they were in much more general insurance as well, but companies like Prudential were invested in because they threw off this steady dividend string. Nowadays that isn't the way it works. With-profit is a much smaller part; it doesn't produce a consistent profit stream, because of the lower interest rate environment, and so forth. And they're now simply looking at reporting profits in the short-term. And so the valuation methods take an excessive priority because they drive investor sentiment ... the world is being driven by the valuation practice rather than reflecting reality. (Chamberlain interview)

The transition that Chamberlain describes is strongly bound up with the distribution of epistemic authority. In what Chamberlain describes as the 'old days', insurance was for investors a 'black box', whose performance could only be measured by investors through the dividends that it generated. Whether the 'engine' underneath the bonnet of the car was sound and would be able to sustain such dividend streams was up to the actuary. In contemporary insurance, however, insurers periodically produce representations of the processes that take place underneath the bonnet of the car through market-consistent valuation and risk capital calculations and leave investors to decide whether the profit streams promised by the insurer are 'credible'. Inevitably, the representations thus produced are suited to the needs of the investor, and are focused on short-term changes. The decline of



actuaries' epistemic authority, in other words, made the economic and regulatory representations of insurance more influential in shaping today's actions and thereby tomorrow's outcomes of insurance.

The increased centrality of risk in life insurance companies was not only fostered by a regulatory injunction to perform risk calculations, but also by the legitimisation of risk management as a profitable activity – a development that reflected changes in the broader corporate context of the 1980s and 90s (Power, 2007). Modern finance theory suggested that investment returns should always be relative to investment risk; profit and risk were simply different sides of the same coin. In life insurance, it was only in the mid-2000s that risk became central in business strategy. In the early 2000s, insurers appeared to conduct risk calculations primarily for compliance purposes or simply because it was considered 'good practice' to do so (Bartlett *et al.*, 2005, p. 3). Since then, however, insurers increasingly 'embraced the value adding aspects of risk management' to the extent that 'good risk management' was increasingly considered a 'competitive advantage' (Deighton *et al.*, 2009, p. 521). The value-creating potential of risk management was described as follows: 'Ideally, a company wishes to hold the minimum amount of capital required to meet its risk appetite, and create a win-win situation for shareholders and policyholders alike' (Deighton *et al.*, 2009, p. 521). Having appropriate risk management tools in place, in other words, would not only facilitate a better understanding of risk (and thus benefit policyholder protection), but would also improve shareholder value by minimising excess reserves given companies' risk appetite. Risk management, in other words, was framed as a device to balance the interests of policyholders and shareholders.

The proliferation of risk management practices was reflected in insurers' changing governance structure. A survey conducted by the FSA in 2003 indicated that while most insurers had set up a separate 'risk assessment function' (37 out of 39), the number of employees dedicated to the function was rather small (3 on average). Moreover, only two companies had appointed an executive level chief risk officer, while one company was planning on doing so (Dowd *et al.*, 2008, p. 9). The results of a survey conducted in 2004 showed some significant changes: of the 39

companies surveyed, 21 now had a chief risk officer and 30 had a risk committee (Bartlett *et al.*, 2005, p. 2). The size of the risk function, moreover, had increased to an average of five (Bartlett *et al.*, 2005, p. 7). Thus, as the ICAS regime was implemented, the number of professionals that concerned themselves with ‘risk’ as an object to be assessed, measured and managed grew.

With the introduction of new tasks within insurance firms, so began the Abbotian (1988) jurisdictional struggles among professional groups as to who would be best suited to perform risk management work. With the emergence of risk management in insurance, the two preeminent ‘financial risk management’ experts Kevin Dowd and David Blake wrote, ‘the stage was set for a classic turf war’ (Dowd and Blake, 2006, p. 221). While actuaries had ‘been accustomed to thinking of themselves of “the” risk experts’, they wrote, ‘the FRM [financial risk management] profession had the advantage that it had a flagship, the VaR, that took center stage: VaR was the flavor, not just of the month, but of the entire decade, and everyone wanted a “VaR model”’ (Dowd and Blake, 2006, p. 221). Within the actuarial profession, the rise of risk management was presented as an opportunity for the actuarial profession. In his Presidential Address, the consulting actuary Nick Dumbreck noted for instance: ‘Even within the insurance sector, the amount of effort devoted to measuring and managing risk seems set to grow significantly in the coming years. This will provide excellent opportunities for actuaries, and we need to be ready to take advantage of them’ (Dumbreck, 2007, p. 9). The educational syllabus of the actuarial profession was amended with a mandatory course on ‘actuarial risk management’ in 2005. After the actuaries of the life insurance, general insurance, and investment kind, the American actuary Stephen D’Arcy prognosticated, the risk management actuary would be the ‘actuary of the fourth kind’ (D’Arcy, 2005).<sup>34</sup>

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<sup>34</sup> In his presidential address for the American Casualty Assurance Society, D’Arcy noted that he borrowed the expression from the renown financial risk management scholar Paul Embrechts. The division between the actuaries of the first three kinds was made by the Swiss actuary, Hans Buhlmann (1989).

The centrality of risk as an object to be managed was reflected not only by the emergence of a ‘risk function’, but also by insurers’ increased use of derivatives. In the 1990s, derivatives usage was only marginal. Paul Fulcher, who was an actuary at Friends Provident before he started working for various investment banks from 2001 onwards, remembers, for instance, that by the late 1990s he ‘would have had no idea what an interest rate swap or swaption was’ (Fulcher interview). As mentioned above, the resilience reserve test was introduced to take the risk embedded in the guarantees into account when calculating reserves. Nevertheless, the resilience reserve test did rather little to push insurers to adopt derivative strategies. As Fulcher recalls, ‘by the end of ’93 we were holding a lot of money against interest rates falling another 100 basis points, say. But it wouldn’t have occurred to you to go and get an interest rate swap or an interest rate swaption because you wouldn’t have thought of it like that way’ (Fulcher interview). The only sort of derivatives that were widely used, according to Fulcher, was for short-term equity protection.

You might buy some equity protection pretty much every year-end, but it’d be very short-dated. It would almost be: look, we’re going away, it’s the start of December and we’ve already worked out what our bonus declarations are going to be. And we sort of worked out and are happy with our balance sheet. ... Well, we better, sort of, lock that in. So you might buy some equity protection that would literally expire in two or three weeks, just to lock in the sort of balance sheet over year-end, almost on the grounds of, well, that way we can all go home and enjoy Christmas. (Fulcher interview)

Andrew Chamberlain similarly recalls that in the pre-ICAS regime ‘the use of derivatives to meet balance sheet tests was relatively low’ (Chamberlain interview).

In the early 2000s, however, insurers increasingly started purchasing derivatives. The case of Equitable Life had made painfully clear what the dangers of unprotected interest rate exposures were, and the bursting of the Dotcom bubble put further downward pressure on insurers’ equity holdings. Moreover, as insurers started *enacting* the guarantees as financial options by modelling them as such, the choice to hedge their exposures with derivatives became a ‘thinkable’, and perhaps even logical one. At this point, Fulcher remembers:

investment banks suddenly realised that they could sell ... interest rate derivatives. You know, they had these instruments – things like swaptions – that had a remarkably similar profile to the exposures that insurance companies had sold to their customers... but they needed actuaries to help sell them basically. (Fulcher interview)

Among the investment banks that started hiring actuaries were JP Morgan, UBS, RBS, Nomura, Deutsche Bank and Goldman Sachs. At the investment banks, however, actuaries tended to experience a very steep learning curve – ‘if Google had not been invented, or the internet, I would have struggled to do my job. I spent my first six months, you know, at UBS just looking up things on the internet that all my colleagues took for granted’ (Fulcher interview). The investment banks started hiring actuarial expertise not only to get a better understanding of life insurance but also to gain insurers’ trust. As Fulcher continued to explain, ‘most of my clients perhaps ... trust the bank I work for, because they trust me, if you see what I mean. That was part of the job in one sense. So, I trust him [the actuary], I don’t trust the bloke he brings to meetings with him [the investment banker], but, you know, at least I trust him’ (Fulcher interview). As the actuarial profession is rather small, individual members are likely to know each other or, if not, at least to have acquaintances in common. Investment banks hired actuaries not only for their expertise but also to benefit from actuaries’ professional networks and cultural identification to engender trust (Granovetter, 1985). In their position at the investment banks, these actuaries straddled across different professional ecologies strengthening the coalition of actors favouring the use of the valuation and risk management techniques of modern finance.

Initially, the actuaries at investment banks spent much of their time modelling. While in the early 2000s, most insurers had bought a proprietary economic scenario generator from Barrie & Hibbert or Deloitte (as discussed in the previous chapter), these ‘were models designed to do calculations rather than models designed for financial management’ (Fulcher interview). The models produced by the investment banking actuaries – which typically were of the ‘replicating portfolio’ kind discussed in the previous chapter – were ‘sort of quick and dirty’, but ‘fit for purpose’, as Fulcher put it. They were, for instance, much quicker to run. As a result,

the investment banking actuaries often helped insurers to do ‘hedge diagnoses’, or the modelling of insurance balance sheets for management purposes. Insurers would pay investment banks for such modelling services by buying the derivatives of them. The business model, in other words, was ‘quid pro quo’: ‘we’ll sell you the insurance to do the financial management, but we’ll help you with the modelling’ (Fulcher interview). This model worked well for investment banks, who were keen on selling something that requires ‘a bit of analysis and intellectual value added’, for it would mean that they would be ‘not just in competition on cheapest price’, but could ‘charge a reasonable amount for it, because it’s tailored’ (Fulcher interview). Hedge diagnosis was an important part of the service that investment banks sold to insurers.

Over time, however, modelling became a smaller part of the investment banking actuary’s job. This was partly the result of insurers’ expanding internal risk managing activities. As the ICAS and realistic balance sheet regimes were implemented, insurers increasingly ‘realised the importance of financial management’ and ‘got the expertise themselves’ (Fulcher interview). As a consequence, Fulcher noted, ‘there’s people at insurers who understand the financial instruments better than I do... Quite commonly ... they would actually understand investment banking products at least as well as I do, if not better’ (Fulcher interview). This changed the business model of over-the-counter derivatives too. As Fulcher put it, ‘now it’s much more, clients basically tell us, this is the derivative we need.’ ‘And so the model sort of “we’ll do some analysis, and then you’ll pay us by doing the derivatives with us” has become quite hard’ (Fulcher interview). As insurers increasingly performed the enactment of insurance guarantees as financial options ‘in-house’, competition in the market for over-the-counter derivatives for insurers revolved increasingly around price.

The implementation of the ICAS regime was indirectly an important driver of increased derivatives usage by requiring insurers to enact financial risk in certain ways rather than others. The ICAS regime, however, also fostered the use of derivatives in a more direct sense. It required insurers to perform balance sheet tests. Rather than assessing whether a company’s funds were sufficient for ‘running-off’ its liabilities, the ICAS required companies to assess whether their funds were sufficient

to cover the market consistent value of the liabilities in one year's time in all but the worst of 200 scenarios. Although some considered the difference between run-off and one-year VaR measures 'artificial', the choice nevertheless seems to have been consequential.<sup>35</sup> It rendered capital requirements manageable with derivatives.

Derivative contracts with a maturity of, say, 20 years may not readily be available (and if they are, they may be rather expensive); derivatives with a one-year maturity, however, are much more abundant. Indeed, interviewee data indicates that derivatives were used to 'manage' the balance sheets so that they could stabilise their capital position and give off a positive impression to investors.

## Conclusion

As the epistemic authority of the actuarial profession declined, alternative devices had to be deployed to make life insurers' promises to policyholders, shareholders, and regulators appear credible. Such alternative devices were found in the form of market-consistent valuation and risk-based capital, which were pushed by a coalition of actors that straddled across different professional ecologies and indeed different fields. In the previous chapter, we have seen that market-consistent modelling derived legitimacy from its perceived objectivity. In the case of risk modelling, however, no such 'objectivity' exists. Risk modelling requires 'forecasting', and, as such, is recognised by actors to be situated in the realm of expert opinion. The 'credibility' of risk models is produced through the interaction among relevant actors (shareholders, consultants, regulators, supervisors, actuaries, etc.) and in reference to quite a distinct vocabulary of justification. As argued above, modellers may draw on 'archival-statistical knowledge' to justify modelling assumptions by extrapolating past trends into the future, but by itself, 'archival-statistical knowledge' is considered inadequate. 'Expert judgment' is another resource for justifying modelling

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<sup>35</sup> Seamus Creedon, for instance, explained this as follows: 'I think if you had perfect foresight about the position one year hence, such that your provisions one year hence reflected a reasonable view of the run-off position at that point, then there is really no difference between a full run-off and a VaR to the one-year point where you have a fresh set of technical provisions' (Creedon interview). For Creedon, in other words, there is no conceptual difference between the measures because the market-consistent value of a liability takes into account the amount of assets needed today to sell off all risk to a third party, or the amount of capital needed to run-off the liabilities with some degree of certainty *and* expect a profit.

assumptions. More generally, the need to justify particular modelling assumptions may be reduced by adhering to ‘market consensus’ as reflected in industry benchmarks.

As a consequence of the proliferation of risk modelling in insurance practice, driven in no small part by a changing regulatory regime, ‘risk’ has become an increasingly central object in the UK’s life insurance market, even if modellers do not necessarily perceive representations of risk as accurate. In conjunction with market-consistent models, life insurers’ risk models enact insurance policies as bundles of risk that can be ‘managed’ through derivative strategies. Indeed, derivative usage by life insurers started increasing throughout the 2000s. This had consequences not only for the composition of life insurers’ investment but also for the composition of the life insurance field. The role of actuaries as custodians of surplus diminished while shareholders acquired a more prominent role in assessing the credibility of future profitability. The changing composition of the field was also reflected in the entrance of various investment banks, who started hiring actuaries to establish trust with insurers and to do some of the ‘cruder’ modelling required to ‘manage’ insurers’ balance sheets. Within this context, risk modelling developed, at least partially, as a collective activity that involved not just companies’ actuarial or finance teams, but also supervisors, modellers at investment banks, actuarial consultants and academics. The epistemic authority of actuarial expertise was partially displaced by consensus generating mechanisms.





## Chapter 7

# Fixing Paradigms: European Capital Regulation

In 2016, the UK's parliamentary Treasury Committee started an investigation into Solvency II, a European regulatory framework for insurance implemented earlier that year, but that had long since been in the making (work on it had started in the early 2000s). The Committee, chaired by the Conservative MP Nicky Morgan, reported:

Evidence gathered ... suggested that Solvency II is a fundamentally sound regime, but that the legislation has been developed within a legalistic and rules-based framework which at times is interpreted as rigid truth instead of on the merits of the case. Furthermore, the implementation in the UK has, arguably, lacked proportionality. (Treasury Committee, 2017c, p. 18)

In their contributions to the Committee, industry practitioners and professional organisations unfavourably compared Solvency II to the UK's previous regime. Yet, UK actors were important advocates of Solvency II, which (similar to the Individual Capital Adequacy Standards or ICAS) was market-consistent and risk-based. 'Solvency II was what the UK wanted', supervisor BA said. 'Solvency II is an Anglo-Saxon regime' (interviewee BA). Now, it seemed, the same UK actors were amongst the most avid proponents of changing the regime. In an exemplary comparison between the ICAS regime and Solvency II, the CEO of the UK's Prudential Regulation Authority commented on the 'matching adjustment' – a specific aspect of Solvency II that will be discussed in more detail below – that 'the stricter and tighter nature of the rules around this instrument, under Solvency II versus its predecessor under ICAS, have led us into a world where, in order to make some of these things work, we have added complexity' (Woods in Treasury Committee, 2017b, p. 10). Brexit, some argued, would provide 'an opportunity to make refinements to the current regime that ensure it is more appropriate for UK insurers and customers' (Association of British Insurers, 2016, p. 2) by separating the British insurance field from the European field in an attempt to reclaim a decisive role for domestic state actors in shaping fields.

In examining the gestation of Solvency II, this chapter suggests that in order to understand what caused the change of heart of many British actors it is necessary to understand the social and political dynamics of rule following and writing. In particular, it is necessary to look at how market-consistent valuation was institutionalised in the market field. Under the ICAS regime, market-consistent valuation (chapter 5) and risk-based capital calculations (chapter 6) were already institutionalised, but their institutionalisation remained relatively *implicit*, limited to a set of broad principles. What those broader principles meant in practice was to be decided by insurance companies and supervisors. With Solvency II, however, many of the valuation and risk capital calculation rules were made *explicit*. Doing so, I suggest, was an attempt to ‘fix’ the meaning of market-consistent valuation. This, then, is the aim of this chapter: to investigate where this urge to ‘fix’ the meaning of market-consistent valuation came from, and the challenges that came along with it ultimately leaving many British actors eager to rescind the regulatory framework they had been in favour of.

The chapter proceeds as follows: I first place the Solvency II project within the context of European integration and describe the politics of regulatory harmonisation for European life insurance. In the second section, I characterise the politics of Solvency II by arguing that the institutionalisation of evaluation practices gave rise to a potentially infinite Wittgensteinian regress to define what market-consistency means. I then describe how the distribution of authority of European capital regulation shaped processes of rule writing and following. In the penultimate section, before the conclusion, I describe three controversies around Solvency II and show how in each of these cases seemingly technical, ‘micro-political’ issues became overtly political.

## The Solvency II Project

Changes in the regulatory regime of UK life insurance cannot be understood without the European context. Particularly important is the process of European market integration, which began in the 1950s. Early efforts towards harmonisation by a subcommittee of the Organisation for European Economic Co-Operation, tasked with

the integration of insurance markets, conflicted with the traditional actuarial mechanism of dealing with uncertainty through the principle of prudence. Capital requirements on top of already ‘prudent’ valuations would punish those member states whose practices were already the most prudent (Daykin, 1992; Sandström, 2016). Across member states, moreover, ‘different perceptions’ prevailed ‘of what life insurance is about’ (Pool, 1990, p. 33).

Nevertheless, with the passing of the European Community’s First Life Directive, the first European solvency rules for life insurers were put in place in 1979.<sup>36</sup> A key question was to what extent capital requirements should be based on ‘implicit’, reflecting actuarial expectations about future performance, and on ‘explicit’, calculated on a ‘retrospective’ basis, such as past claims expenses or premium income. While practitioners preferred the use of ‘implicit’, regulators preferred ‘explicit’, arguably so ‘because one does not need to be an actuary to understand what is involved’ (Pool, 1990, p. 36). ‘Explicit’, moreover, were independent of mathematical reserves, rules for which the first life directive left to national supervisory authorities. The First Life Directive was a compromise between explicit and implicit: its solvency margin was based not on mathematical reserves, like earlier proposals had suggested, but on past claims expenses and premium income; valuation rules, however, remained a domestic affair.

Some degree of coordination on valuation rules was achieved with the passing of the Third Life Directive. The *Groupe Consultatif des Associations d'Actuaires des Pays des Communautés Européennes* (or simply *Groupe Consultatif*), a European association of professional bodies set up in 1978 to represent actuarial interests to European legislative bodies, played a crucial role in this. The First Life Directive did not lead to the desired cross-border activity and the European Commission perceived diverging valuation rules as an important barrier. It therefore adopted a strategy of ‘minimum harmonisation’, a form of negative harmonisation that seeks to establish

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<sup>36</sup> The first non-life directive, which is very similar to the first life directive, was passed several years earlier, in 1973. The main reason for the difference in timing was that the life directive was much longer as it dealt with the issue of ‘specialisation’ – whether insurers should be allowed to write both life and non-life assurances. Disagreements on this took a long time to resolve (Pool, 1990, pp. 33–34).

minimum standards whilst facilitating cross-border market access. In so doing, national regulatory regimes would face pressure to converge towards the minimum standard. In a way, ‘minimum harmonisation’ thus sought to utilise ‘competition politics’ – a form of politics in which actors mainly seek to promote the international competitiveness of domestic industries (Mügge, 2006) – as a mechanism to level the playing field across different states (Story and Walter, 1997). To achieve this, the Commission asked the *Groupe Consultatif* to carry out a survey on whether ‘different methods or bases for calculating technical reserves ... lead to significantly different protection for policyholders in different members states’, and whether they lead ‘to significant distortions of competition if the principle of a “single license” with “home country supervisions” were adopted throughout the European communities’ (Wilkie and Horsmeier, 1990, p. 2).

The survey was carried out by two members of the *Groupe’s* Life Assurance Committee, the Dutch actuary Harry Horsmeier and the British actuary David Wilkie, whom we encountered in chapter 3. European insurance markets differed quite substantially. ‘Some countries regulated premiums and reserving tightly, prescribing the basis, and letting companies compete on bonuses. Others, like the UK, were more relaxed’ (Wilkie in personal communication). However, the *Groupe’s* report, which had been composed by Wilkie and Horsmeier and was amended by other members of the Life Assurance Committee, concluded that ‘in spite of different methods and bases for calculating technical reserves ... each method provides ample protection for domestic policyholders’ (Wilkie and Horsmeier, 1990, p. 72). Moreover, the report noted that ‘any attempt to introduce uniformity of methods or bases for calculating technical reserves ... would be inappropriate, unnecessary and harmful’, and recommended that, instead, ‘the relevant directive should contain a statement of actuarial principles’ (Wilkie and Horsmeier, 1990, p. 72).

After having submitted the report, the *Groupe* retained a strong influence on the directive. The committee employed two actuaries, who, as Wilkie recalls, ‘felt that they needed a bit of help’ and hence asked the *Groupe Consultatif* ‘to draft a set of valuation standards’ (Wilkie in personal communication). The chair of the

*Groupe's* Life Assurance Committee, Theo Heiligenberg, phoned up David Wilkie and asked him whether he could come and see him in the Netherlands that weekend. Wilkie, who had already arranged to go to Switzerland that Saturday, arranged a stopover at Schiphol airport where he sat down with Heiligenberg and Horsmeier in a restaurant and 'spent about three hours' drafting a set of valuation principles. The initial draft favoured a 'bonus reserve valuation', a type of gross premium valuation that would also take into account future bonuses and would be performed on a prudent basis. Various members of the *Groupe Consultatif's* Life Assurance Committee, however, preferred a more traditional, net premium type of approach (see chapter 5). For instance, as Wilkie remembers, one of the German members of the committee 'did not like the idea of a "breathing balance sheet"' (Wilkie interview), the assets and liabilities of which would go up and down as market conditions change. Other actuaries, including the other UK members, similarly preferred the 'net premium valuation' method.

The Third Life Directive eventually allowed for a wide variety of valuation methods to be used. It prescribed a 'prospective' bonus reserve valuation but also permitted a net premium valuation on a 'retrospective' basis. The directive, a former regulator recalls, 'progressed harmonisation of asset and liability values; didn't achieve it, but progressed it' (interviewee BC). The directive, moreover, prescribed that companies should make the valuation basis and methods available to the public. The directive thus institutionalised the UK's 'freedom with publicity' regime at the European level and effectively entrenched the use of 'implicit' valuation practices such as the net premium valuation (Penrose, 2004).

Around the turn of the century, however, things started to change: the launch of the Financial Services Action Plan in 1999 and the prospect of a single currency shifted regulators' focus towards positive integration (Quaglia, 2010) – an objective that had previously proved difficult to achieve. The series of directives passed in the early 90s, however, had contributed to the emergence of large financial institutions that operated in multiple member states and had a competitive interest in furthering the integration of domestic market fields into a single European one (Mügge, 2006). In 1999, moreover, the Economics and Finance Ministers Council had set up a

‘Committee of Wise Men’ led by the Hungarian central banker Alexandre Lamfalussy to make recommendations on streamlining the regulatory process. The Committee recommended a four-level procedure in which the negotiation of high-level regulations (level 1) and lower level technical specification of those regulations (level 2) would be separated. (Level 3 consisted of guidelines issued by supervisory authorities; level 4 of enforcement mechanisms.) Whilst level 1 regulations would be designed by the European Commission and were to be approved by the Council and Parliament, specialised committees would lead the development of level 2 regulations. The recommendations of the Committee were adopted in 2001 and facilitated the negotiation of a series of directives, including the influential Markets in Financial Instruments Directive in 2004. The Lamfalussy process helped speed up the regulatory process by turning what were previously political issues into technical ones (e.g. Mügge, 2006).

Solvency II was the first piece of insurance regulation following the Lamfalussy procedure. Although early work on insurance solvency regulation had started in the late 1990s, the project ‘really only started in 2004’, Karel Van Hulle, head of the Insurance and Pensions unit at the European Commission between 2004 and 2013, said (Van Hulle interview). In prior years, it had become clear that reforms of the solvency regime would take time. The Commission therefore decided to ‘detach’ some early wins (adopted in the Solvency I directive, which mostly consolidated already existing directives) and initiated a more fundamental review of solvency requirements (interviewee BC; François, 2015). In 2004, the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) was set up, which together with the European Commission started drafting a new regime.

In the years prior to 2004, however, important decisions had already been made. Particularly influential were two reports commissioned by the European Commission: the ‘Sharma report’ by the Conference of European Insurance Supervisors (2002), the predecessor of CEIOPS, which was headed by Paul Sharma of the UK’s Financial Services Authority; and the KPMG report. The Sharma report was based on an analysis of insurance failures and near failures and concluded that the main cause of failure was often poor risk management, not inadequate capital

standards. It implied that new solvency regulations should not just establish quantitative requirements, but also improve insurance governance. The KPMG report, on the other hand, focused on practical recommendations. As one of its authors remembers, the report was not ‘strikingly original, but it drew quite heavily on Basel concepts’ (Creedon interview). The report proposed a three-pillared structure similar to the Basel regime for banking, in which the three pillars would outline respectively quantitative, corporate governance and disclosure requirements. The ‘pillar 1 requirements’, moreover, would be based either on an ‘internal model’ or a ‘standard formula’ that would be ‘scenario-based and not factor-based’ (Van Hulle interview). Both reports provided the basic contours of the Commission’s ‘framework for consultation’ – a document with draft regulations that would be updated along the way – and thus had helped set the policy agenda (Van Hulle interview).

A central aspect of Solvency II’s design (well established by 2004) was that a European regime, like the UK’s domestic regime, should be ‘market-consistent’ (see chapter 5). For Quaglia, this similarity was evidence that the British had successfully ‘uploaded’ their domestic regulatory template to the European level. Indeed, ‘British policymakers chaired key committees and were regarded as points of reference in the debate’ (Quaglia, 2011, p. 115). The choice for market-consistency, however, also articulated well with broader international developments in banking regulation, accounting standards and, indeed, nascent efforts towards international insurance solvency standards by the International Association of Insurance Supervisors. Again, as noted in chapter 5, market-consistency thus gained broad support from actors across different professional ecologies, which endowed it with critical force. Market-consistency, moreover, was regarded as a necessary precondition for an ‘explicit’ risk-based capital regime. It thus quickly became one of the few principles from which the European Commission ‘was not willing to diverge’ (Van Hulle interview; cf. Mügge, 2011). Nevertheless, what market-consistent valuation meant in practice was the focus of extensive debate and political negotiation (as discussed below).

Thus, at the core of Solvency II is a market-consistent balance sheet that may look different from one day to the next (were it to be calculated on consecutive days,

which in reality it is not). It is a ‘breathing balance sheet’ of the type that some supervisors had previously rejected. For the European Commission’s regulators, this ‘breathing’ was a good thing: ‘We work with living animals. Not with dead things, you know,’ Van Hulle (2014) remarked. Solvency II was designed to stimulate active risk management, on behalf of both insurance companies as well as their supervisors. In contrast to Solvency I, for instance, it contained an ‘early warning system’. Solvency requirements comprised two components: ‘minimum capital requirements’, calculated as the amount needed to remain solvent on a market-consistent basis in 85% of one-year scenarios; and the higher ‘solvency capital requirements’ that should provide sufficient capital for 99.5% of the same scenarios. The solvency capital requirements were intended as ‘soft’ requirements: breaching these requirements would lead to extra regulatory scrutiny and the need for a recovery plan; only when the minimum capital requirements were breached would the company be forced into ‘run-off’ (i.e. to close its doors to new business).

## Rules, Paradigms and the Micro-Politics of Regulation

Whilst it was established early on that Solvency II would be market-consistent and risk-based, it was less clear what this would mean in practice. Indeed, I argue, much of the politics surrounding Solvency II revolved around the meaning of market-consistency. In this section, I seek to describe this form of politics by looking at the ways in which actors may seek to influence what it means to comply with the general principles of market-consistent valuation and risk-based capital calculation.

To claim that much of the politics can be understood as shaping the meaning of market-consistency may be surprising considering that, as noted in chapter 5, one of the attractions of market-consistency was precisely that it would be more ‘objective’. A regulatory system that would better reflect the ‘true’ economic substance (as defined by the hegemonic paradigm of no-arbitrage modelling) of insurance products would thus provide an apolitical (or, at least, a less political) basis for the legitimacy of capital regulation. At the same time, it would be a means to reduce opportunities for ‘regulatory arbitrage’ (Swain and Swallow, 2015) – the exploitation of differences between the ‘economic substance’ of insurance products



and the regulatory representations thereof or between the regulatory treatment of functionally equivalent products across different fields (Fleischer, 2010; Riles, 2014).

Indeed, regulatory arbitrage was an important motivation for Solvency II, which promised to reduce the discrepancies between capital regulation regimes across the increasingly integrated adjacent fields of banking and insurance. Since the 1980s, for instance, the business model of ‘bancassurance’ – the sales of insurance products through bank branches – became increasingly widespread, not so much in the UK but more so in Portugal, Italy, Spain and France (Sterzynski, 2003). By reducing the gap between insurance and banking capital regulation, Solvency II promised to foreclose opportunities for bancassurers to exploit differences in how the balance sheets of insurance entities and banking entities were treated in distinct regulatory regimes (European Central Bank, 2007). For those countries in which bancassurance became a dominant model of insurance provision (countries in which the fading of the boundaries between the insurance and banking fields had been most pronounced), the promise to foreclose this regulatory loophole at the very least weakened the opposition of insurance regulators towards market-consistent valuation.

Thus, apart from the hegemonic status of market-consistent valuation itself, Solvency II also promised to circumvent some of the problems of ‘competition politics’ by aligning regulatory representations of value and risk with hegemonic economic representations thereof. However, I argue, attempts at doing so irrevocably leave gaps and fissures – ‘rough edges’ in the words of Andrew Smith (Smith interview) – that constitute a space for politics. These gaps and fissures are, in part, the result of the indeterminacy of rules, but are also constituted by *a tension between paradigmatic and rule-based knowledge*. As noted in chapter 2, paradigmatic knowledge (conveyed through exemplary problem solutions) is often seen as irreducible to an explicit set of rules, which is partly because the criteria for *how* a paradigm should be extended to new problems are contingent on the setting in which the paradigm is to be applied. The meaning of a paradigm is ‘relational’ (Daston, 2016; Hacking, 2016) and its extension requires decisions, either implicit or explicit.

The translation of market-consistent valuation into an explicit set of rules thus involves two moments in which social and political factors may play a role: 1) the extension of paradigmatic knowledge into a set of rules; and 2) decision making about what constitutes rule conforming behaviour.

The tension between regulatory (rule following) and economic (paradigmatic) representations of value and risk thus brings to the fore the question of micro-politics, which, I suggested in chapter 2, refers to subterranean struggles over seemingly technical issues. Actors may seek to influence not only the wording of rules but also the scope of behaviours that are accepted as complying with those rules. In so doing, actors may argue that a particular instance is an exception that falls outside the intended scope of the rule. If successful, regulators may be forced to rewrite the rules to reflect this renewed meaning – they may be forced, in other words, to take a step into the Wittgensteinian ‘infinite regress’ (see chapter 2). This regress is potentially infinite because rules in themselves are incapable of determining their application and it is thus impossible to ‘fix’ their meaning simply by writing more rules. Only when causal factors allow implicit or explicit decisions to be made effectively may the infinite regress be put to a halt.

In some cases, the micro-politics of evaluation may become overtly political. An example will serve to illustrate the point. In 2015, the European Commission published a green paper with proposals for its Capital Markets Union programme, which included proposals to help incentivise private investment in infrastructure assets. As part of this programme, the European Commission decided to amend Solvency II, by creating a new asset class in the standard formula for infrastructure investments. The capital requirements for this new asset class would be lower than the reserves needed to back other types of equity investment.<sup>37</sup> For Smith, ‘the figures that have been come up with [for infrastructure assets] are clearly inconsistent with other asset classes’ (Smith interview). The political demand for

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<sup>37</sup> Although the standard formula is only used by some companies, it is also used as a ‘benchmark’ to assess the adequacy of companies’ internal models.

infrastructure investment trumped the epistemic standard of consistency to which Smith alludes, and led to the writing of more detailed rules.

## The Distribution of Epistemic and Supervisory Authority

Having argued in the previous section that the politics surrounding Solvency II can be described as a form of micro-politics that in some cases may become overtly political, I now turn to the locus of that politics: the actors that are involved in the writings of the rules and the ‘communities of interpretation’ (Thiemann and Lepoutre, 2017; Thiemann, 2018) that determine the scope of their appropriate application. More specifically, I focus on the distribution of different forms of ‘authority’ – understood in the Barnesian (1986, 1988) sense as a delegated discretionary capacity (conferred by the state) to determine the appropriate application of a paradigm (in the case of ‘epistemic authority’) or a rule (in the case of ‘supervisory authority’). The more the authority to write rules and the authority to supervise their application coincide, the more likely rules are to enable and constrain the behaviour of those subject to it effectively. The more fractured this authority becomes, however, the more flexible the application of rules will likely be, and the more slippage there will be between the intention of a rule and its actual application.

In chapter 5, I argued that the UK transition towards a market-consistent regime was related to broader shifts in the distribution of authority. Whilst traditional valuation models required actuarial judgment on the future, market-consistent valuation models sought to circumvent the need to forecast the future by recasting the question of value in no-arbitrage terms. Actuarial authority, in other words, was replaced by the ‘objectivity’ of no-arbitrage models. At the same time, supervisors started playing a more active role in judging whether firms appropriately applied market-consistent valuation and risk calculation techniques. The role of actuaries changed accordingly: they increasingly became ‘technical’ experts concerned with developing the techniques that allowed firms to comply with the principles of market-consistent valuation and risk-based capital calculation.

With Solvency II, there were further changes in the distribution of authority – changes that would have important implications for insurers’ knowledge machinery.

Among the more significant changes was that the authority to decide how things like value and risk should be calculated became increasingly located with supervisors, in particular with CEIOPS (and from 2014 onwards EIOPA, or the European Insurance and Occupational Pensions Authority). CEIOPS had an important influence on level 2 regulations, which were formally ‘adopted by the European Commission’, but ‘prepared by the supervisory authorities on the basis of a specific mandate from the Commission’ (Van Hulle, 2011: 296). Level 2 regulations were crucial, because, as Van Hulle noted, there was a ‘tendency’ at level 1 to push problems downwards’ (Van Hulle interview). Thus, whilst the ‘principles’ underpinning Solvency II ‘could be agreed rather quickly ... the real debate was to be had on the elaboration of those principles’ (Van Hulle interview) – a debate in which supervisors played a key role.

With supervisors who increasingly acquired ‘epistemic confidence’, the influence of the actuarial profession on the regulatory process declined. Indeed, the delegate of the Royal Dutch Actuarial Association to the Actuarial Association of Europe (AAE) at the time, Ad Kok, recalls that while the European Commission had seemed to be receptive to the AAE’s advice (‘they understood this was consultancy free of charge’), CEIOPS appeared rather less so. The biannual meetings of the AAE with CEIOPS appeared to Kok primarily as ‘one-way traffic’ (Kok interview). ‘We then said, we can do this, we can do that. Yes, that was heard, and, well yeah, many thanks. That was that’ (Kok interview).

Despite the fact that Solvency II was, in some sense, a continuation of the UK’s domestic regime, there were also important differences. In the UK’s domestic regime, both the authority to write rules and to supervise their application had been *centralised* – even if supervisors might have been more receptive to external advice. In the European context, however, the distribution of authority was *layered*: while CEIOPS did most of the rule writing, responsibility for supervising how those rules were applied in practice was located with domestic supervisors. Although CEIOPS was given the authority to supervise supervision, this nonetheless meant that domestic supervisors had some degree of discretion in shaping the rules. To the extent that the objectives of domestic supervisors differed from those of CEIOPS,

there was thus a tension between the rule-writing authority and the authority to supervise their application.

The objectives of CEIOPS and domestic supervisors did indeed differ. Whilst ‘convergence of supervisory practices’ was a key objective of CEIOPS (2006), domestic supervisors faced entirely different pressures. As Singer (2007) notes, national regulators and supervisors face two main pressures that are typically in tension with one another. On the one hand, the primary objective of the PRA is to protect policyholders by avoiding economic catastrophe. On the other hand, however, regulators and supervisors may also be engaged in ‘competition politics’ (Mügge, 2006). Apart from the fact that supervisors may have a ‘competition objective’ (as was the case with the Financial Services Authority and later the Prudential Regulation Authority or PRA), making them responsible for maintaining effective competition, they protect the interests of the domestic industry in the international field.

Supervisors and regulators continuously face these opposing pressures – pressures that in some cases may become rather manifest. In the hearings cited earlier, for instance, the Treasury Committee wondered whether the fact that the competition objective of the PRA was secondary had meant that it was subdued to the primary objective of policyholder protection. This was what private practitioners and consultants had intimated in earlier hearings. When Phil Smart, partner at the insurance practice of KPMG, suggested that the PRA’s stringent reading of Solvency II had led to excessive capital requirements, the Conservative MP and then chair of the Committee, Andrew Tyrie, asked: ‘So the consumer is paying more than he or she needs in premiums, to enable the regulator to sleep more easily in his or her bed?’ (Tyrie in Treasury Committee, 2017a, p. 3).

Politicians may thus be concerned about the level of stringency that supervisors apply in shaping how rules are applied in practice. In another instance, for example, the Conservative politician Jacob Rees-Mogg asked Woods:

Can it possibly be found, on a uniform basis across the EU, that an industry that most of us would think was quite strong in the UK turns out to be the third-weakest in Europe? How would you

explain the figure that comes out of 142% solvency ratio in the UK, 272% in Germany and in Italy—Italy—a 243% solvency ratio. ... If you take the Italian figure and the UK figure, if you did it on the same basis for both countries, you may find that the difference is not 101% between the solvency ratios of the UK and Italy. (Rees-Mogg in Treasury Committee, 2017b, p. 14)

Rees-Mogg suggested, in other words, that UK supervisors applied the rules relatively strictly, putting UK insurers at a structural disadvantage vis-à-vis other insurers. In addressing Rees-Mogg's query, Woods suggested that even if the application of the rule had not been 'absolutely universal', the PRA had stuck to epistemic standards in determining the appropriate application of the rules. 'We have just said what our view of longevity is, being reasonable about it', he claimed, suggesting that a weakening of the standards would unduly subject the primary objective of policyholder protection to the competition objective. Supervisors may thus refer to epistemic standards to fence-off political pressure to weaken regulatory standards.

The efficacy of regulation may thus depend on the balance between the different pressures that are exerted on supervisors. Another important factor is the relation between the supervisor and the supervised (Thiemann and Lepoutre, 2017; Thiemann, 2018). Regulators may be well aware of this. Consider, for instance, this extract from a speech by Van Hulle:

Today, many countries when they do insurance supervision, it's basically somebody sitting behind a desk and reading lots of reports and things and filings and whatever. Not anymore in the future. In the future, insurance supervisors will actually have to know who they are supervising. And establish a dialogue. ... the insurance industry should look at the supervisor as their friend. Not their enemy. That's the logic of Solvency II. No organised war between the supervisor and the supervised. ... And because we are fully transparent – pillar 3 – we can actually talk to each other, because we know each other. ... Ladies and gentlemen, these companies are your lifeline. You make money from them. So you better take care of them. ... And it is this trust that is very important in the philosophy of Solvency II. (Van Hulle, 2014)

Van Hulle was thus advocating for closer ties and more trust between supervisors and supervisees. This objective, however, succeeded only partially. On

the one hand, the exchange between supervisors and firms intensified under Solvency II. A good indication of this is the cost of supervision: HM Treasury estimated, for instance, the one-off cost of Solvency II incurred by the UK's Prudential Regulation Authority at £105m, while the ongoing costs of IT maintenance and increased supervisory resources were estimated at £3.3m per year (Regulatory Policy Committee, 2015). But while the interactions between supervisors and supervisees proliferated, the nature of the relation, according to Van Hulle, did not appear to be based on trust. 'The insurers didn't trust the supervisors. And the supervisors themselves didn't trust the insurers' (Van Hulle interview). The absence of trust had important implications for Solvency II.

The insurers came to me and asked me: what does this principle mean in this specific case? I often said to the insurers: don't ask me that question, because I will then have to write a rule. Use your common sense. Apply this principle in the spirit of Solvency II. But the insurers had difficulties with this, because they said, as long as the principles aren't clear, the supervisor is going to impose all sorts of things on me, because the supervisor is going to interpret the principles. I need something to hold onto. Similarly, insurance supervisors wanted more detail because they were afraid that this was the only way to enforce the principles in practice (Van Hulle interview)

Insurers feared that the domestic regulator would apply the rules rather strictly, thus preferring CEIOPS to 'fix' their meaning. The competitive dimension between the different national industries thus powerfully pushed CEIOPS to fix the meaning of rules by writing them on a rather granular level.

Thus, whilst in the UK's domestic regime authority was centralised within the supervisory agency, authority at the European level was layered – distributed across the European supervisory authority (CEIOPS) and domestic supervisors. This, I suggest, introduced a tension between the objectives of those who write the rules and those who supervise their application. Within this context, the nature of supervisor-supervisee and supervisor-supervisor relations – characterised by an absence of trust – were an important driver of the proliferation of rules.

## Fixing Paradigms, Fixing Rules: Between Purism and Pragmatism

So far in this chapter, I argued, firstly, that the translation of the paradigm of market-consistent valuation into concrete rules involved two moments in which actors could seek to shape the meaning of ‘compliance’ (Edelman *et al.*, 1999) – the translation of paradigms into rules and of rules into concrete (rule-following) practices. In both these moments, I suggested, a tension between epistemic and political considerations may emerge. Secondly, I argued that the structure of epistemic and supervisory authority in the context of European regulation provided an incentive for supervisors to ‘fix’ the meaning of the rules. In the rest of this chapter (divided in three subsections), I analyse three distinct aspects of the Solvency II regime in which the tension between epistemic and political considerations played an important role: the construction of a risk-free curve used for discounting the value of liabilities; the ‘matching adjustment’; and the ‘risk margin’.

### *Constructing a risk-free curve*

In previous chapters, I argued that discounting is a crucial aspect of insurance valuation. In market-consistent valuation, discounting is done with a ‘risk-free rate’ (see chapter 5). Although the idea may seem simple, in practice it may be difficult to determine when an interest rate is risk-free. ‘There is no such thing as a risk-free rate’, interviewee BC suggested, for instance. ‘It is a theoretical construct. It’s not something that exists in reality’ (interviewee BC). Interest rates on government bonds are often considered a close approximation of real risk-free rates, even though, as interviewee BC noted, ‘even sovereigns have risk’ (interviewee BC). None of the market interest rates thus perfectly represents the risk-free rate. Yet, considering the large impact that even small differences in the discount rate may have for the valuation of (particularly long-term) insurance liabilities, finding a common interpretation of the risk-free rate was considered crucial.

The construction of a market-consistent discount curve thus requires important decisions. First, should the risk-free curve be derived from government bonds or from derivative instruments like interest rate swaps? Although government



bonds are typically regarded as the safest assets available (even if not entirely ‘safe’), interest rate swaps are perceived to have some distinct advantages too (Dullaway and Needleman, 2004; Sheldon and Smith, 2004). The use of Eurozone government bonds, for instance, caused idiosyncratic problems, because their yields tend to diverge. Discounting at the interest rate on government bonds would thus cause the same liability to be valued differently across member states – an outcome that would be clearly unpalatable to countries whose interest rates on sovereign debt are lowest (Smith interview). The choice between swaps and government bonds, in other words, involves a trade-off.

Second, decisions needed to be made about how the risk-free curve should be extrapolated to maturities that were not readily available in financial markets. In some countries, the maturity of guarantees may exceed the maturity of actively traded (or ‘liquid’) government bonds or interest rate swaps. In Germany for instance, David Hare, a consulting actuary and former president of the IFoA, explained, some insurers ‘sell pension policies to 30-year olds that look very similar to a deferred annuity to us’ (Hare interview). In that case, the maturity of the guarantee may be 60 to 70 years into the future. What, then, should be the *market-consistent* risk-free rate to value this guarantee? How should the risk-free curve be extended beyond the maturity of instruments available in the market? And if there were instruments available, though perhaps not liquid, should these be used in the construction of the curve? Or should the curve be based only on ‘liquid’ instruments?

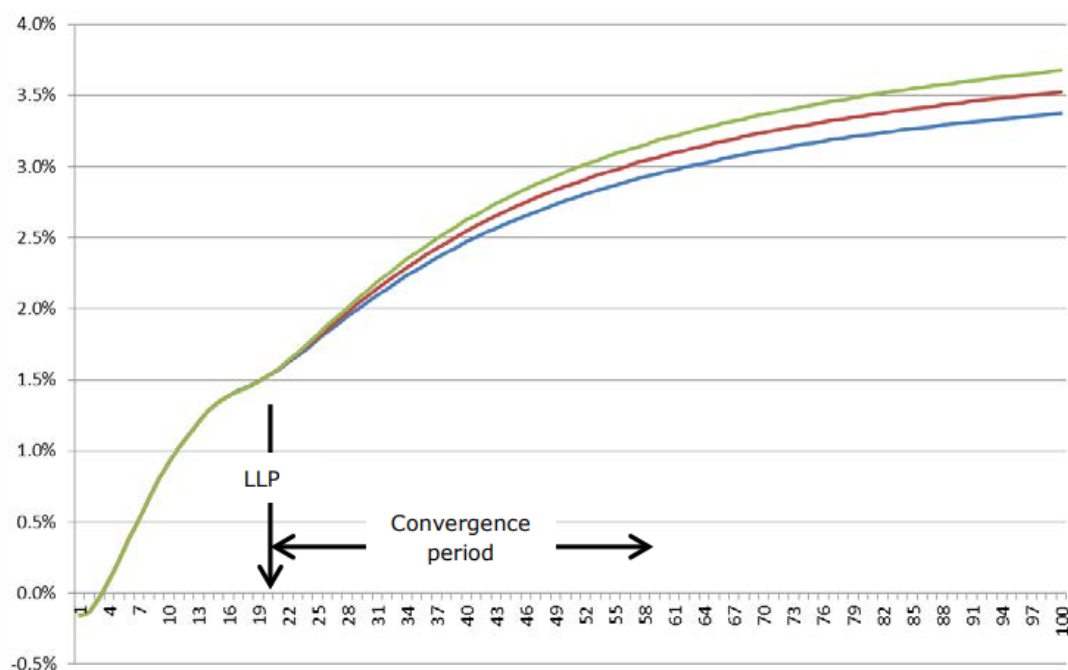
The pressure to close the gap between the concept of the risk-free rate and observable market rates was eventually resolved by locating the authority to construct the risk-free curve with EIOPA, limiting the influence of other stakeholders to consultations on its methodology. When the Solvency II directive was adopted by the European Commission, Parliament and Council, its only prescription for the discounting regime had been the use of ‘the relevant risk-free interest rate term structure’ (Directive 2009/138/EC, p. 46). What this phrase would mean in practice (following Lamfalussy procedure) was left for level 2. In 2014, five years after Solvency II had originally been accepted, however, the European Commission passed a new directive, Omnibus II, which amended some of the principles laid out

in the original directive and introduced some additional measures affecting the calculative basis of Solvency II (on these latter measures: see below). Crucially, Omnibus II provided that the risk-free curve should be determined by European Insurance and Occupational Pensions Authority (EIOPA), which succeeded CEIOPS as the centralised supervisory organ. ‘In order to allow for the consistent calculation of technical provisions’, the directive motivated this decision, ‘it is necessary for a *central body* to derive, publish, and update certain technical information relating to the relevant risk-free interest rate term structure on a regular basis’ (Directive 2014/51/EU, p. 5; emphasis added).

The centralisation of epistemic authority rendered the subterranean conflicts around discounting manifest, resulting in a debate ‘with EIOPA on one side, and the industry on the other side’ (Creedon interview). In the debate about the risk-free curve, two main strands of argument were prevalent: one perceived as pragmatic, the other more theoretical. Those favouring the theoretical approach appealed to epistemic standards of consistency and argued that the curve should be based on as much market information as possible, even if some assets were in reality hardly traded. Whilst some argued that only liquid interest rates should be used (typically up to a maturity of about 20 years), others argued that also illiquid prices beyond those 20 years should be taken into account. Indeed, according to Smith, ‘a theoretically pure perspective will be to say: “we’ll just use the market curve. Why are we kidding ourselves that the market prices beyond 20 years are perfectly relevant for valuing assets [valued at ‘market value’], but not for valuing liabilities [when valued at an extrapolated rate of interest]? That doesn’t really make any sense”’ (Smith interview).

The pragmatists, however, pointed out that doing so might be problematic. ‘There’s not a [liquid] 60-year Euro market’, Hare noted. Indeed, many considered market liquidity to be limited at around 20 years of maturity. ‘So what are you going to do for the other 30 or 40 years [needed to value liabilities like those in Germany]? If you extrapolate out constant spot rates or something like that, then you could just create solvency issues for a number of foreign insurance companies - and potentially serious issues for some’ (Hare interview).

The choice made by EIOPA was to construct a curve using three key concepts: 1) the last liquid point or the last point at which interest rates were considered ‘liquid’; 2) the ‘ultimate forward rate’, or the rate to which the curve would converge at infinite maturity, which for euros was initially set at 4.2%<sup>38</sup> (a reflection of inflation expectations and a projection of real interest rates); and 3) a method used to extrapolate the curve beyond the last liquid point (see figure 7.1). EIOPA’s approach was pragmatic because it ignored some of the available market data for less liquid instruments.



**Figure 7.1** The risk-free curve as constructed by EIOPA (2016). The figure shows what the curve would look like for three different values of the ultimate forward rate. The size of the ultimate forward rate is respectively 4.4% (green), 4.2% (red), and 4.0% (blue).

Critics of EIOPA’s approach argued that it introduced inconsistencies that were theoretically indefensible, in particular with respect to the ultimate forward rate.

<sup>38</sup> Many considered this rate too high, especially as interest rates continued to decline. EIOPA (2016) therefore proposed a new methodology for deriving the ultimate forward rate on an ongoing basis. As before, the derivation was based on central banks’ inflation target (different for different currencies) and a historical average of real rates. For euro-denominated liabilities, the new ultimate forward rate was calculated at 3.65%, significantly lower than the previous ultimate forward rate. To limit the impact on the balance sheets of companies with long-term guarantees on their books, the rate of change was capped at 15 basis points annually (which meant, e.g., that in 2018 – the first year in which the new methodology was applied – the ultimate forward rate was 4.05%).

The rate, Hare explained, was supposed to represent ‘what the market would price on very long term things if the yields existed’ (Hare interview). To the extent that this resulted in a risk-free curve diverging from available, albeit perhaps ‘illiquid’ market data, a new problem was introduced: ‘those yields don’t exist. So how do I do my asset and liability matching when I’m pretending that I’m getting yields which I’m not’ (Hare interview). Smith similarly noted:

You can observe [swap] prices out to about 50 years and in current market conditions, a 50-year rate is about 1.5%. So insurers within the Eurozone will be discounting that liability at somewhere around 4%. But if they held those 50-year swaps, they’d value them at 1.5%. So you’ve got an inconsistency between the assets and liabilities. (Smith interview)

Using an ultimate forward rate higher than any of the available market rates compromised what some perceived as the ‘theoretical purity’ of market consistent valuation by permitting the use of different valuation rates at the asset and liability side of the balance sheet – an inconsistency that prevented (particularly German) insurers with long-term guarantees from appearing ‘bust’, but also potentially complicated insurers’ ‘matching’ investment strategies. Nevertheless, EIOPA clung to its methodology - a compromise between political consideration of insurers’ balance sheets and epistemic arguments about market consistency and the ‘matching’ or ‘hedging’ rationale.

#### *When is an interest rate risk-free?*

The debate surrounding the ultimate forward rate was essentially a calibration problem. Although opinions differed on what a market-consistent rate would look like on the long term, the meaning of ‘risk-free’ remained relatively undisputed on shorter terms. In another debate, however, the meaning of risk-free was precisely what was at stake: what did risk-free mean if insurers were able to benefit from higher returns on their assets than implied by the interest rates on swaps and government bonds without running the extra risk?

The claim that insurers were able to obtain returns on their investments higher than risk-free rates without running additional risk ran counter to modern finance

theory. According to modern finance theory, there should be no such thing as a ‘free lunch’ (see chapter 5). Any yield in excess of interest rates on AAA-rated government debt was compensation for additional risk – the risk premium. If this was not the case, investors could profit from the price discrepancy, increasing the price of the instrument to such an extent that the excess spread would again be equal to the risk premium. Hence, in a market-consistent regime, liabilities should be discounted at government bond rates, or, indeed, swap rates.

As the financial crisis unfolded, however, some insurers started seeing risk-free discounting as problematic. Initially, this was primarily the case for UK annuity providers who ‘matched’ their liability cash flows with investments in corporate bonds. After the collapse of Lehman Brothers, the ‘excess spread’ on corporate bonds over government bonds soared. In pre-crisis years, spreads had remained relatively stable in the UK around 40-50 basis points for the safest of corporate bonds (AAA-rated), while the spread for riskier bonds (BBB-rated) varied between 100 and 200 basis points. At the peak of the crisis, the spread for the AAA-rated bonds had increased to nearly 300 basis points, while the BBB-rated corporate bonds yielded an excess of more than 650 basis points over the risk-free yield on the UK’s sovereign debt (FSA, 2009). If Solvency II’s discounting regime had already been implemented, UK annuity providers would have been in trouble: while interest rates dropped and the market-consistent value of liabilities increased, the market value of their assets plunged. The widening spreads wreaked havoc on the market-consistent solvency position of annuity providers.

Seeking to protect the annuity industry, British supervisors lobbied for changes in the calculative basis of Solvency II. Initially, not all countries were convinced. As one supervisor remembers:

...it was the UK which originally pushed for a more market consistent type of system, and you had the French at the time screaming that they wanted to stay on a historical cost and so on. And then when the British changed their mind, just slightly changed their mind ... effectively the French were fully convinced market consistent people. (interviewee BA)

The stance of other member states changed, however, with the onset of the Eurozone sovereign debt crisis. Continental European insurers like Allianz were heavily invested in the sovereign debt of some of the affected countries (Basse, Friedrich and Kleffner, 2012), similarly to ‘match’ some of their long-term promises to policyholders while benefitting from higher yields. The sovereign debt crisis thus influenced continental insurers’ willingness to change the calculative basis of Solvency II.

The main justification for such changes revolved around ‘liquidity risk’ – as noted before, the risk that an investor is forced to sell an asset at a time when the demand for that asset has declined substantially. For insurers, some argued, this risk was negligible, even if at least part of the risk premium on illiquid assets should be regarded as compensation for liquidity risk. To the extent that insurers ‘*match*’ their liabilities with fixed-income investments like corporate and sovereign bonds, there would be no risk of the insurer being forced to sell its assets. Thus, by investing in ‘illiquid’ assets insurers were compensated for a non-existing risk. The risk premium ‘has an element of a free lunch for them’ (Smith interview).

Although many agreed there was some truth in this claim, it was difficult to estimate the size of the illiquidity premium. Indeed, for this reason, it seems, much of financial economic theory has tended to abstract away from liquidity risk. The models in asset pricing theory discussed in chapter 5, for instance, assume that financial instruments are fully liquid and can be continuously traded at their ‘true price’. The same goes for market-consistent valuation:

...the whole framework that we were looking at for market consistency just failed to have anything to say about liquidity effects. It was all in this theoretical world of perfect markets. And you buy and sell things, it doesn't move the price; you can observe the price, you can trade as much as you want for that price, and the price doesn't move as a result of your trading. And all of that is definitely wrong for things like residential property. If you try to buy a house, you realise what a complete fiction that is. (Smith interview).

The financial crisis, moreover, exacerbated the epistemic problem:

I think we all thought we understood how spreads worked, and we all understood that [you have the] risk-free rate and then you add on a bit for the credit risk, then there is a bit left that you can't explain, which is the – which you explain, it's the illiquidity risk. And yes this made a few basis points difference here and there. And then we discovered with the global financial crisis we didn't understand spreads at all. And actually ... they could become very large. And we didn't have a methodology at that point to say to ourselves ... when a spread increases significantly in size, how much of that is the market reappraising credit risk? How much of that is actually liquidity? (Interviewee BC)

There was, in other words, no established method to measure the liquidity premium. Estimations of how large the liquidity premium on different assets would be, moreover, tended to vary. Nonetheless, with insurers and supervisors aligned, the European Commission set out to draft amendments to the market-consistent framework of Solvency II that were included in Omnibus II, the same directive as mentioned earlier. The so-called long-term guarantees package allowed insurers to use either a 'matching adjustment' or a 'volatility adjustment'. With a 'matching adjustment', insurers could take credit for 65% of the spread between the return on eligible portfolios with matching assets; with the volatility adjustment, they could take credit for 35% of the spread on all portfolios.

With these adjustments, was Solvency II still market consistent? Some believed this not to be the case, arguing that the adjustments were at best in tension with some of the basic principles of modern finance theory, even if the existence of an illiquidity premium might, in some cases, be plausible. As noted above, propositions like the efficient market hypothesis precluded the existence of a 'free lunch'. According to interviewee CJ, 'in theory, the matching adjustment can only contain risks that you're not exposed to, which of course begs the question: well, why is the market charging a credit spread ... if it's not for risk' (interviewee CJ). Similarly, Smith argued, 'if you had sent a kind of a pure professor to go away and build a model, and prescribe how it was to be done, they might have come up with something much closer to the work we did in the 1990s and the early 2000s, which was sort of theoretically pure. But then you've got these rough edges about illiquidity; what you do with it? And we've got to compromise there' (Smith interview).

For others, however, Solvency II remained faithful to market-consistency, even with the adjustments. Indeed, they pointed out that market-consistency is an ambiguous concept that allows for multiple interpretations. In a press interview, for instance, Van Hulle stated: ‘All these people who are now shooting at these solutions for long-term guarantees, these adjustments, and say this is not market consistent. My question is what is market-consistent? Where does it say in stone, in the Bible, that there is only one way to deal with this issue?’ (Benari, 2013). Indeed, he argued, ‘it’s time in insurance that people start to look beyond their plate and move away from the old theory and take account of what is happening in the real world’ (Benari, 2013). At the core of this debate was the question ‘who owns the label of the risk-free rate,’ interviewee BC posited. ‘If you have an illiquid liability, and you discount it using the liquid risk-free rate plus a liquidity premium, isn’t that still a risk-free rate (interviewee BC)?’

Pragmatic concerns for the viability of the annuity market thus led supervisors to reconsider the meaning of ‘risk-free discounting’, and, with that, the meaning of ‘market-consistency’. Without the matching adjustment, capital requirements on annuity providers would be too onerous, they argued, increasing the cost of selling annuities. For those concerned with the theoretical coherence of the valuation practices, however, the adjustments remained unsatisfactory. In the absence of a method for estimating illiquidity premiums consistent with no-arbitrage pricing theory, the matching adjustment allowed insurers to ‘capitalise’ on parts of the risk premium that *might* not be genuine compensations for illiquidity. The matching adjustment, itself a compromise between the considerations of incumbents and internal governance units in the market and epistemic fields, could thus be seen as a further step in an ‘infinite regress’ (see chapter 2) to specify the meaning of ‘market-consistency’ and ‘risk-free discounting’.

A (temporary) halt to the infinite regress required one further step: the rule only applied to eligible assets that, according to the directive, should amongst other things produce cash flows that are ‘fixed and cannot be changed’ (Directive 2014/51/EU, p. 22). At the Treasury Select Committee hearings, the consulting actuaries Jane Portas, Andrew Chamberlain and Phil Smart argued that supervisors’



interpretation of ‘fixed’ was too strict. The Prudential Regulation Authority (PRA), for instance, did not permit insurers to apply the matching adjustment to liabilities that were backed by investments in ‘equity release mortgages’ – mortgages that allow borrowers to ‘release’ cash from their mortgage by ‘selling’, de facto, part of their equity stake to the mortgage lender. Annuity providers were keen to invest in these assets because their complexity and concomitant illiquidity meant they were yielding relatively high returns. Indeed, Chamberlain submitted, the equity release mortgages ‘do not have a guarantee of when the money will come out’, Chamberlain said. However, ‘[i]f you have sufficient of them – using the laws of large numbers – you have an expectation that you will get a cash flow that is pretty reliable’ (Treasury Committee, 2017a, p. 6).

The PRA was thus pressed for a more ‘flexible’ interpretation of the rules by considering the cash flows produced by equity release mortgages as fixed. In response, the PRA allowed insurers to apply the matching adjustment to the senior tranches of securitised assets like equity release mortgages, which ‘could be 80-90% of the cash flows’, David Belsham, non-executive director of the PRA, said. ‘In a way, we are stuck with the rules as they are written, but the PRA is trying to operate them in as flexible a way as possible’ (Treasury Committee, 2017b, pp. 8–9). For the PRA, there was some flexibility as to how this could be interpreted, but it also perceived some clear limits to the flexibility: it argued that ‘fixed’ cash flows could only be produced by ‘fixed-income’ assets, not by any other assets, even if average cash flows were highly predictable. The interpretation of the eligibility criteria thus formed another step in the infinite regress, as the PRA was pushed to clarify when a cash flow was ‘fixed’.

#### *A market price for non-market risks*

Another area of contention similarly revolved around an element that was considered theoretically justified, but which proved harder to capture in rules capable of marshalling widespread agreement. The object was the so-called ‘risk-margin’, which, according to Victoria Saporta, Executive Director of Prudential Policy at the PRA, is ‘the margin above the best estimate of the liabilities ... to try to make the liabilities market consistent’ (Saporta in Treasury Committee, 2017b, p. 16). As

noted in chapter 5, market-consistent valuation practices seek to assign a market price to the financial risks embedded in an insurance contract. For insurance-related risks, however, no such market price exists; for these risks, market-consistent valuation models use a ‘central’ or ‘best estimate’. If market-consistent models assigned a value to insurance liabilities that would reflect their market price, an additional margin was required to compensate for non-market risk. The risk margin, in other words, was intended to represent the market price for ‘non-hedgeable’ risks (Directive 2014/51/EU).

Like the ultimate forward rate and the matching adjustment, the risk margin became rather controversial. To calculate the risk margin, CEIOPS recommended a ‘cost-of-capital’ approach, which would reflect the return that shareholders require on solvency capital. Critique of the risk margin ranged from practical to epistemological arguments. As David Belsham remembers, who before becoming a non-executive director of the PRA in 2014 was chief actuary at Prudential, ‘we liked not having a risk margin. It’s not needed because you can run off the liabilities’ (Belsham interview). The solvency capital itself already provided sufficient capital to run-off liabilities confidently. Others, however, argued that the risk margin failed to measure what it was supposed to measure. Andrew Smith, for instance, argued that at least part of the risks included in the solvency capital requirements were ‘diversifiable’; hence, following modern portfolio theory (see chapter 5), shareholders would not require compensation for those risks. The risk margin was too sweeping, Smith argued. ‘[W]hen Solvency II first came out, I argued against including the risk margin, and said: “the risk margin is going to end up being roughly proportional to your capital requirements. So why don’t you just multiply the capital requirement by something and require people to hold 200 percent rather than a 100 percent”’ (Smith interview)? Doing so ‘would have the same effect and be much simpler’ (Smith interview). Moreover, Smith argued, other aspects of Solvency II, like the ultimate forward rate, had already undermined the concept of market-consistent values reflecting the price at which insurers could sell their liabilities. ‘If you’re trying to buy out those liabilities, you’re going to find anybody who’s going to give you credit for earning 4.2 percent beyond 20 years? Well of course you’re not. Nobody is that stupid when they’re actually buying the liabilities’ (Smith interview).

Despite these critiques, the risk margin became part of Solvency II, but not without its problems. As interest rates started to decline after the financial crisis, the size of the risk margin started to increase. This was because the cost-of-capital was measured at a flat rate, while the future cash flows thus generated were discounted at the risk-free rate. As interest rates declined, the size of the risk margin increased. Particularly affected were insurers with large ‘non-hedgeable risks’, like annuity providers with lots of ‘longevity risk’ on their books. In some cases, the risk margin made up around half of the insurer’s technical provisions (i.e. the risk margin doubled the value of the liabilities). Woods, moreover, estimated that a change of 50 basis points in the risk-free rate could mean a 20% change in the risk margin (Woods, 2015, p. 4). Consequently, insurers argued that the risk margin introduced ‘artificial volatility’ in their balance sheets – a point that Woods agreed with. ‘The risk margin is a place’, he said in front of the Treasury Committee, ‘that we all agree is overcooked’ (Woods in Treasury Committee, 2017b, p. 16).

The main justification for adjustments in the risk margin was expressed in macroprudential vocabulary. The sensitivity of the risk margin to the risk-free rate, UK supervisors argued, meant that it ‘has potentially a pro-cyclical effect and the effect of making this risk margin much bigger than it should otherwise be at the moment’ (Woods in Treasury Committee, 2017b, p. 24). In the wake of the financial crisis, procyclical investment behaviour – investment behaviour that feeds into and strengthens cyclical market dynamics – became a major concern for regulators across the globe. The notion of procyclicality emerged in the early 2000s as part of a broader discourse on macroprudential regulation – regulatory efforts that focused not just on how individual companies were run but also on systemic issues. In 2008, Baker (2013) argues, macroprudential regulation rapidly became the ‘principal interpretative frame’ for responding to the financial crisis. Indeed, the FSA identified ‘hard-wired procyclicality’ as one of the major underlying causes of the crisis (FSA, 2009). In later years, the Bank of England set up a ‘Procyclicality Working Group,’ which among other things published a report on the investment behaviour of insurance companies and pension funds. The report intimated that changes in regulation, valuation and accounting practices potentially contributed to strengthening what already appeared as procyclical investment behaviour on behalf

of insurance companies (Haldane *et al.*, 2014). In 2017, a Bank of England staff working paper explicitly linked the risk margin to procyclical investment behaviour (Douglas, Noss and Vause, 2017). Thus, when the risk margin requirements surged (for UK annuity providers in particular), macroprudential discourse provided a legitimate vocabulary for articulating motivations to change the risk margin methodology.

In the UK, both industry and supervisors agreed on the need to change how the risk margin was calculated. The risk margin, however, was somewhat of an idiosyncratic British problem; EIOPA, therefore, perceived the need to make changes in the risk margin less urgent. Efforts led by the PRA to implement changes in the way that the risk margin would be calculated in advance of the planned Solvency II review in 2021 failed – an outcome that was reportedly influenced by the UK’s decision to leave the EU (Tanner, 2018). In response, the PRA resorted to a proposal by Legal & General that it had rejected previously. According to the proposal, the PRA would allow insurers to commit to future management actions such as the reinsurance of longevity risk, which could reduce future capital requirements and therewith also today’s risk margin. The effect would be significant: the Association of British Insurers estimated that Legal & General’s proposal could reduce UK insurers’ total risk margin requirements (estimated at £50bn) by about two-thirds (Tanner, 2018). With such substantial interests involved and weary of conflicts with EIOPA, the PRA decided to postpone the implementation of this ‘fix’ until after the UK would have left the EU, which, at the time of writing (May 2019), is yet to happen. Nonetheless, what the struggles between EIOPA and the PRA show is that when the structure of supervisory authority changes (from ‘layered authority’ to ‘centralised authority’), so may the rules – even if the words of the rules remain the same.

## Conclusion

When I asked interviewee BC, who was involved in many of the regulatory initiatives described in this chapter, about the tension between the ‘scientific’ basis of market-consistent valuation and the political considerations that shaped Solvency II,

he replied by quoting Saint Augustine: ‘make me virtuous, oh lord, but not yet’ (interviewee BC). According to interviewee BC, there was initially widespread agreement about what a good regulatory framework, consistent with the dominant economic paradigm, would look like. ‘And then people started getting the bill. Oh dear, this is a bit painful. And then, just as things were beginning to settle down, the financial crisis came along, and oh my goodness, that bill that we thought was going to be quite painful is now hugely painful’ (interviewee BC). As interviewee BC’s response suggests, what was understood as a ‘pure’ application of market-consistent valuation, by some epistemic standards, would have brought forth a reality that was politically unpalatable. The boundary between the epistemic field and the market field faded and much effort was expended in the process of rule writing and following to reshape both the meaning of a ‘pure’ application of market-consistent valuation and risk-based capital calculation (as, e.g., in the case of the matching adjustment), and, moreover, to find compromises between epistemic standards and political considerations (as, e.g., in the case of the ultimate forward rate). The result, Solvency II, is thus neither purely a ‘pragmatic’ nor purely a ‘dogmatic’ product, but a mixture of both (cf. Mügge, 2011).



## Chapter 8

### Remaking the Market for Retirement Income

So, the brave new world has dawned: we in the insurance sector are now operating under a new prudential regulatory regime. Solvency II has become ‘business as usual’ – a regime that has appeared, at times, a distant, indeed receding prospect, and which has undoubtedly consumed enormous efforts from all of us in this room - and, let us be frank, as with all far-reaching regulatory change, significant cost - has now been in place for no less than 48 days. (Bulley, 2016b, p. 2)

The above are the opening lines of a speech by Andrew Bulley, Director of Life Insurance at the Prudential Regulation Authority (PRA) at the Investment and Life Assurance Group conference in London. In later speeches, Bulley continued to refer to the world of Solvency II as ‘a brave new world’, a trope that is intriguing for it evokes – intentionally or not – the dystopian world of Aldous Huxley’s novel by the same title. In them, Bulley described the challenges for supervisors in this brave new world. He noted, for instance, that ‘one of the risks of a prudential regime that permits firms to calculate their own capital requirements is that the system, over time, is gamed’ (Bulley, 2016b, p. 8). Indeed, he suggested, this was what had happened pre-crisis in banking, where the total value of banks’ risk-weighted assets had steadily declined in pre-crisis years, even if leverage (the indebtedness of a bank relative to its capitalisation) increased. ‘[L]eft to its own devices’, Bulley claimed, ‘competitive pressure can exert a steady and determinedly downward pressure on capitalisation’ (Bulley, 2016b, p. 9). It would be the task of the PRA ‘to guard against any pronounced downward drift’ (Bulley, 2016b, p. 9).

One of the areas that Solvency II had already impacted was the management of longevity risk and the nascent market for ‘bulk annuities’ – a product typically sold by insurers to pension funds in which the insurer promises to pay a series of cash flows that perfectly match with (some of) the pension fund’s liabilities in exchange for a lump sum payment. Since the mid-2000s, pension schemes

increasingly purchased these annuities – which are structured either as an asset owned by the pension scheme (in the case of a ‘buy-in’) or as the issuance of insurance policies to individual scheme members (in the case of a ‘buy-out’) – as a means to rid themselves of defined-benefit pension promises. Indeed, Bulley observed a few months later:

Defined Benefit (DB) pension schemes are increasingly looking for ways to reduce their risk exposures.... [M]any commentators have argued that insurers are the natural home for the long term risks associated with pension schemes and so have welcomed this development. (Bulley, 2016b, p. 4)

Although Bulley claimed there were strong arguments that by taking over the defined benefit promises from companies, ‘a wider social good is done’, he also noted there were risks attached to this. For instance, to the extent that firms ‘struggled to price competitively with a corporate-bond based asset strategy’ (a typical asset strategy for UK annuity providers; see chapter 7), Bulley feared they ‘may succumb to the temptation to venture into asset classes where they have no, or limited, experience’ (Bulley, 2016a, p. 5). The transfer of longevity risk was another area about which Bulley claimed the PRA had some concerns. ‘Solvency II’, he noted, could provide firms with a powerful incentive to carry out trades to transfer longevity risk by way of reinsurance’ (Bulley, 2016a, p. 3). Such transactions allow insurers to free up capital to underwrite new risks. In so doing, however, new risks were also introduced. Insurers, for instance, would be heavily exposed to a relatively small number of counterparties (also known as counterparty credit risk) on whose balance sheets increasingly larger concentrations of longevity risk would prevail (concentration risk). Bulley wondered, therefore, to what extent the longevity transfers were really motivated by legitimate risk management considerations and to what extent they were driven primarily by regulatory arbitrage.

In this chapter, I examine the emergence and evolution of the bulk-annuity buyout market, and the role played therein by regulatory initiatives such as Solvency II. In the next section, I review debates about market-consistent valuation in the world of pensions – a field that is closely tied to the insurance field, and, as I argue, is becoming increasingly so due to a convergence of the evaluation of pension and



insurance liabilities. In the section that follows, I then analyse the emergence of the bulk-annuity market within this context, by focusing on 1) the framing of differences and similarities between pension funds and insurance companies; 2) the development of longevity transfer mechanisms; and 3) the bedding down of pricing mechanisms in the bulk annuity market. In the penultimate section, I analyse how market participants compete and how competition was influenced by institutional and epistemic developments. In the conclusion, I return to the question of how changes in the evaluation machinery of insurance companies and pension schemes were entangled with broader developments in the field of retirement income.

## ‘The Liabilities are the Liabilities’

Although debates about market-consistent valuation of insurance and pension liabilities (see chapter 5) emerged at the same time, the knowledge machinery of the pension field was much slower to change. Just as in insurance, the crucial aspect of pension valuation is the discount rate. For most of the twentieth century, pension scheme actuaries determined discount rates by actuarial discretion. Traditional actuarial valuations typically followed some sort of ‘discounted income’ approach, in which liability cash flows were discounted at the ‘book yield’ – the interest rate implied by the ‘book value’ of assets, as opposed to their market value (Turnbull, 2017). Like the traditional valuation of insurance liabilities, pension valuations, actuaries applied the principle of prudence, incorporating implicit margins to deal with adverse events.

Traditional actuarial valuation methods had important implications for pension funds’ investment decisions. If the discount rate was based on the actual ‘asset mix’ of a pension fund, then ‘a change in the equity/bond mix could change the actuarial valuation of assets as well as the actuarial valuation of liabilities’ (Turnbull, 2017, p. 245). Within this framework, equity investment appeared appealing: the risk premium over gilts translated into lower funding requirements on the long term, even if scheme actuaries sought to counteract the extra risk by valuing pension liabilities prudently (Avrahampour, 2015). Equities, moreover, were also seen as a good ‘match’ for pension fund liabilities. They were a type of ‘real

investment’, actuaries agreed, the value of which – in contrast to gilts – would remain unaffected by inflation. Overall, ‘investment philosophy’ had gradually changed from the interwar period onwards, resulting in a large-scale shift from fixed-income to equity investment (Scott, 2002; Turnbull, 2017). By the mid-1970s, equities made up two-thirds of pension fund assets (Holbrook, 1977), with some funds like Imperial Tobacco being exclusively invested in equities (Avrahampour, 2015).

The rationality of the traditional actuarial valuation approach and equity-oriented investment strategies was increasingly disputed from the mid-1990s onwards. As discussed in chapter 5, a new generation of actuaries emerged who were familiar with modern finance theory and argued that traditional actuarial methods were not always appropriate. Even if traditional methods provided useful guidance for an assessment of long-term funding requirements, some started arguing, an assessment of a scheme’s self-sufficiency – a question that became increasingly prominent from the 1970s onwards with increased corporate takeover activity – required a ‘market-related’ methodology, which better suited the need to consider pensioner security (Dyson and Exley, 1995; Turnbull, 2017, p. 255).

By the late 1990s, the issue of pension valuation had become increasingly controversial. Notable was the publication of a paper entitled ‘The Financial Theory of Defined Benefit Pension Schemes’ (Exley *et al.*, 1997). Jon Exley had written the paper together with Andrew Smith, who had worked theretofore primarily on insurance (see chapter 5), and Shyam Mehta, a colleague of Smith at Bacon & Woodrow. For Smith, the way in which pension liabilities were valued – ‘the higher expected returns, and therefore the higher the discount rate and the lower your liabilities’ – ‘seemed so bizarre from a finance perspective’ (Smith interview). The paper sought to present a coherent theory of market-consistent valuation of long-term liabilities and applied it to defined benefit pensions and replaced the question of the level of assets needed to meet expected liabilities, with the question of the level needed to minimise the risk of not meeting the liabilities. In so doing, a market-consistent valuation implied a rather different way of looking at pension funding. According to Cliff Speed, who worked with Andrew Smith at Bacon & Woodrow at

the time and was an avid proponent of market-consistent valuation, it enabled you to ‘think of [defined benefit] pension promises a bit like a debt’ (Speed interview). If a fund’s assets were less than the market-consistent buyout value, a scheme would fall short in case of sponsor bankruptcy. The difference between the market-consistent buyout value and the present value of a scheme’s assets could thus be seen as an ‘unsecured loan’ from the employees to the sponsor’ (Speed interview). The paper was highly influential and became somewhat paradigmatic in later years. According to Speed, for instance, the paper ‘says it all as far as I’m concerned. The things ... which I’ve been involved with in writing, to some degree, are an echo or a restatement of a lot of things in [that 1997 paper]’ (Speed interview). At the time, however, the paper ‘went down like a lead balloon’, Smith remembered. ‘Everybody hated it’ (Smith interview). In the face of opposition from many scheme actuaries, the ‘challenger’ actuaries favouring methods consistent with modern finance theory were less successful in finding a coalition with key actors in the pension field, thus having only limited success in raising market-consistency as a key objective of valuation – at least initially.

The valuation debate came at a time when pension promises were under severe pressure, which at least partially explains the antipathy towards market-consistent valuation. A commission set up by the government to examine the state of pensions argued that since the 1970s various regulatory initiatives had contributed to increasing the cost of pensions. The 1973 and 1985 Social Security Acts, for instance, improved the treatment of ‘early leavers’. In the 1980s, the government introduced mandatory indexation, requiring pension funds annually to increase pension benefits at the retail price index (capped at three and later five percent). Life expectancy had improved significantly as well, the Pensions Commission, which was led by the economist Adair Turner, reported: ‘In the 1950s, when many of the major corporate pensions plans were put in place, with predominantly male members, male life expectancy at 65 was 12 years. Today it is 19’ (Pensions Commission, 2004, p. 121). At the same time, however, ‘exceptional equity returns in the 1980s and 1990s allowed many private sector defined benefit schemes to ignore the rapid rise in the underlying cost of their pension promises’ (Pensions Commission, 2005, p. 123).

Indeed, many companies had lowered their contribution rates. The 1990s, the commission argued, were a ‘fool’s paradise’ (Pensions Commission, 2005, p. 123).

The relatively weak funding of pension schemes started to become problematic in 1995 when the government introduced a ‘Minimum Funding Requirement’ (MFR). It forced pension funds periodically to perform an actuarial assessment of the fund’s financial position. If the actuarial value of assets was below 90% of the value of liabilities (calculated on a traditional actuarial basis), then companies were to produce a ‘recovery plan’. The 1995 Pensions Act, moreover, provided that the trustees of a scheme, in the case of sponsor solvency, could claim the shortfall between assets and actuarial liabilities as ‘debt’, which directly translated the analogy of proponents of market-related evaluation methodologies into law. In 2003, the government changed the basis for calculating the size of the debt from the relatively weak actuarial basis used for the calculation of minimum funding requirements into a full ‘buyout’ basis. How the company specific ‘statutory funding objectives’ (which replaced the minimum funding requirements in 2004) should be calculated, however, was largely left in the hands of the scheme actuary, which, according to proponents of a market-consistent basis, left the valuation vulnerable to ‘fudging’. The legal basis of pension promises thus increasingly coincided with how proponents of a market-consistent approach viewed them; how the economic value of those promises should be calculated less so.

In combination with regulatory changes, pension funds’ weakening financial position contributed to a shift in investment practice and in the form of pension arrangements. Firstly, to the extent that the new regulatory requirements set a floor to pension funds’ funding level, some pension funds sought to ‘de-risk’ their investment strategy, a strategy that was facilitated by market-consistent methodology. The belief that pension funds should invest mainly in equities persisted throughout the 1980s and 90s when it was still taught in actuarial exams. David Dullaway remembers, for instance, that one of the questions on his exam asked what the ‘right asset’ was ‘for a pension fund to buy to back its liabilities’. The answer actuaries were expected to give, Dullaway said, was: ‘you buy equities’ (Dullaway interview). Dullaway, however, was trained in economics and claimed that the

answer ‘clearly is nonsense from an economics perspective (Dullaway interview). Pension liabilities, he argued, were much more like index-linked government bonds. According to a market-consistent investment approach, a well-matched investment strategy was to invest in inflation-linked government debt, not in shares.

At the core of the investment debate was the issue of value. As noted above, traditional actuarial ‘funding’ methods were based on the notion that liability values were contingent on the assets that backed them (Patel and Daykin, 2010). This implied that the value of liabilities would be lower if the assets that backed them were invested in higher yielding (but more volatile) assets. Even if actuaries made some corrections for extra ‘credit risk’, this way of viewing the problem of value gave preference to higher-yielding but also ‘riskier’ equity investment strategies. In a market-consistent world, however, the value of assets and liabilities is independent. In an exemplary expression of this view, proponents of market-consistent valuation argued that traditional actuarial valuations were ‘looking at the wrong side of the balance sheet’, Speed argued. ‘I don't care if I've got equities, if I've got bonds, or there's no assets there whatsoever. The liabilities are the liabilities’ (Speed interview). Because pension liabilities were similar to index-linked government bonds, as Dullaway argued, the liabilities should be discounted using the interest rates on these bonds, regardless of investment strategy. Market-consistent valuation thus provided a new frame for the question of investment: if the value of liabilities was independent of the actual investment strategy, a pension fund could either choose to invest in ‘low-risk’ assets, thereby reducing the risk that the fund would fall short of its promises (a strategy known as liability-driven investment, see: Speed *et al.*, 2003), or invest in high yielding assets in an attempt to close funding gaps. In a market-consistent world, however, the latter strategy could be seen as a form of speculation. Actual investment returns might very well fall short of expected returns, exposing a fund to a larger shortfall than it would have had with low-risk investments.

Secondly, throughout the late 1990s and early 2000s, companies were increasingly reluctant to sustain defined benefit pension schemes. Some companies had already closed their defined benefit pension schemes in the 1980s, but the pace

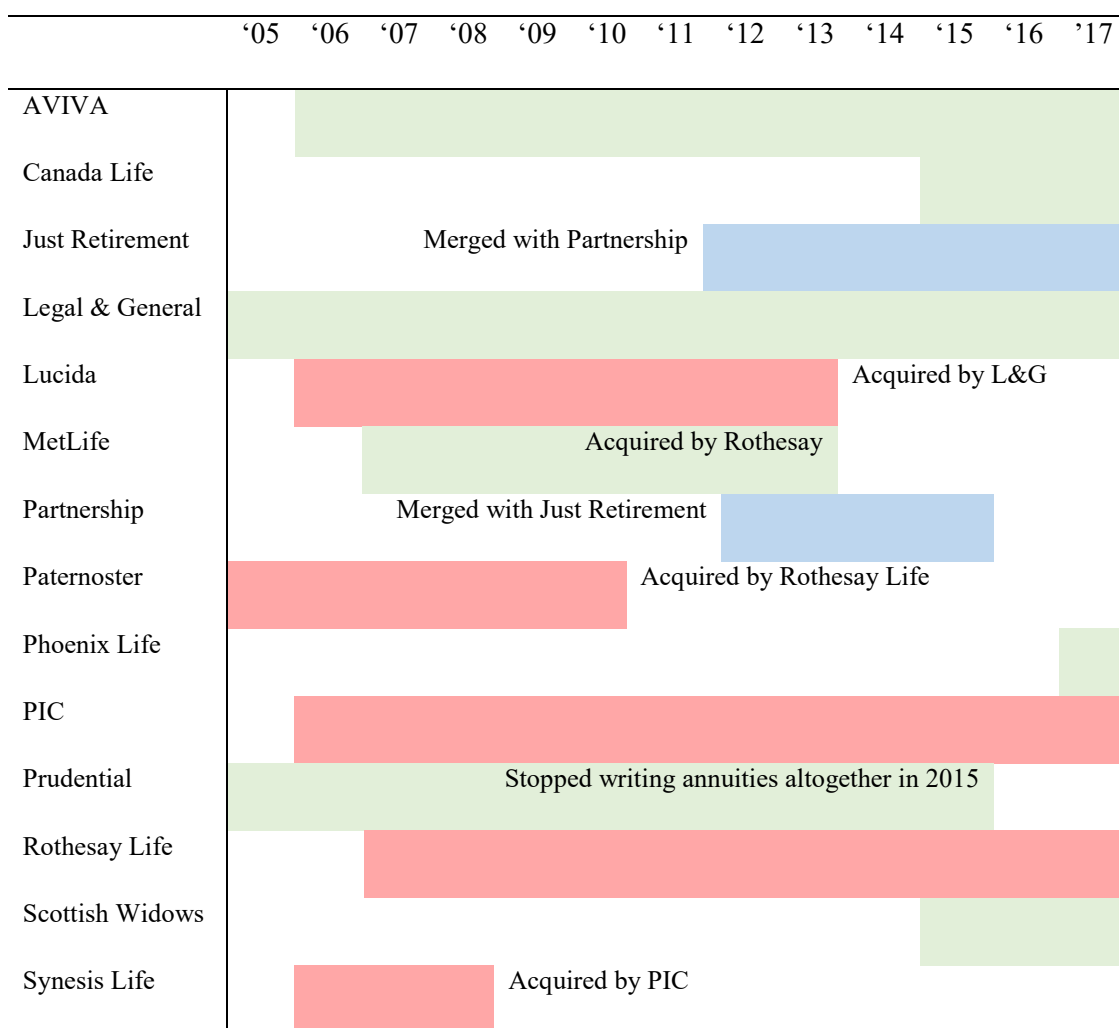
of closure picked up towards the late 1990s and early 2000s. In 1995, there were 5mln active members of open pension schemes, and another 0.2mln active members of closed schemes; in 2000, the numbers were respectively 4.1mln and 0.5mln; by 2005, there were fewer than 4mln active members, equally divided across open and closed schemes (Pensions Commission, 2005). The fast pace at which the defined benefit schemes were closing raised new questions: what should happen to the legacy schemes that would remain in existence until their very last members had died?

## Making a Secondary Market for Retirement Income

For insurers, the closing down of defined benefit pension schemes became a business opportunity. By the mid-2000s, there were few insurers active in the buyout market and the transfer of pension liabilities to insurance companies was rather expensive. The market ‘was quite a niche’, Andrew Stoker recalls. ‘You just had Legal & General and Pru [Prudential]. Pricing wasn’t that competitive’.

When Cliff Speed quit his job in 2005 to become the Chief Investment Officer of the start-up insurance company Paternoster (headed by Mark Wood, who had left his job as CEO of Prudential UK, reportedly when he was not appointed as the group CEO [Northedge, 2008]), ‘some people said it was a surprising thing to go and do’, Speed recalls. ‘There’s a polite way of saying, a lot of my colleagues said I was mad ... you’re going off to try and sell a product, which nobody wants’. Speed’s recollections capture the novelty of the buyout market, even if, considering the activity in the early years of the market, the surprise might not have been as big as the quote suggests. In its first two years, Paternoster succeeded to buyout 32 pension schemes with a total value of £1.7bn (Northedge, 2008). Other start-ups quickly followed in its tracks (see table 8.1). In 2006, the former Prudential CEO Jonathan Bloomer set up Lucida, while the private equity investor Edmund Truell founded Pension Corporation, later renamed as Pension Insurance Corporation, or PIC (Mariathan, 2008). In another manifestation of the fading boundaries between the banking and insurance fields, investment banks and private equity firms backed the start-ups with significant amounts of capital. Paternoster, for instance, received £500mln of starting capital, 40% of which was put in by Deutsche Bank (Northedge,

**Table 8.1** Participants in the bulk annuity market.



Red indicates a challenger firm; green indicates an incumbent insurer; blue indicates a new entrant that is active in the individual annuity market, but is established relatively recently. Data sources: Barnett Waddingham, LCP and Aon.

2008); Pension Insurance Corporation received nearly £900mln starting capital from JP Morgan, Lloyds Banking Group, Royal Bank of Scotland and the private equity firm JC Flowers (Davies, 2011b). In 2007, the investment bank Goldman Sachs set up its own life insurance subsidiary, Rothesay Life, as a vehicle for pension buyouts, reportedly to benefit from cheap funding for its investment activities. The closing of defined benefit pension schemes thus led to the emergence of a secondary market in pension liabilities, an event that the academics David Blake, Andrew Cairns and Kevin Dowd (2008) described as ‘the birth of the life market’. In the rest of this section, I will analyse the emergence of a secondary market for pension liabilities.

### *Levelling the playing field*

Crucial in the emergence of the new life market was the ‘framing’ (Fligstein, 1996) of the role of pension buyouts in the retirement income system more generally. Speed (In: Speed *et al.*, 2008, p. 238) argued, for instance, that the ‘conventional wisdom’ that the provision of retirement income through insurance companies was more ‘expensive’ than through pension funds – a conception that was prevalent in the world of pensions – was rooted in differences between how the evaluation of pension and insurance liabilities was institutionalised. These differences reflect differences in the role of evaluation in the institutional context of pensions and insurance. While pension funds relied on a ‘sponsor covenant’ to make up for any future shortfalls, insurers had no sponsor to rely on and were therefore dependent on capital buffers. Pension liabilities on the balance sheets of pension schemes were therefore valued on relatively weaker mortality assumptions and with a more forgiving discount rate. As a consequence, Speed suggested, if you ‘imagine a pension scheme [becoming] a life insurance company, which, arguably, is the same thing, you'd say it's an insolvent life assurer’ (Speed interview).

In Speed’s view, a convergence of the knowledge machinery underpinning pensions and insurance would eventually ‘level the playing field’. The changes in pensions regulation mentioned above, such as the introduction of minimum funding requirements, contributed to this. Another important factor was the introduction of a new accounting standard in 2002, FRS 17. Jon Exley (2002), one of the avid proponents of market-consistent valuation, commented that even if the accounting standard had ‘flaws that have the hallmarks of compromises with traditional actuarial arguments’, which made the accounting valuations weaker than a market-consistent basis would suggest, he considered it a ‘spectacular improvement in pensions accounting’. The pensions consultant Ronnie Bowie noted that the accounting standard had an important ‘impact’ on bringing the pension problems ‘to boardroom attention’.

I have been doing the job of a pensions consultant for nearly 30 years. I have never known such boardroom and finance director interest in pensions, nor have I ever been to so many full board meetings as in the past three or four years. Occasionally I have



been told that I and all other actuaries are an entire waste of space, and that it is we who got them into this mess, but, more usually, to be invited to discuss how to manage the risks. (Bowie in Speed *et al.*, 2008, p. 239).

Changes in accounting practices and regulatory requirements for pension funds contributed to a narrowing of the gap between valuation in insurance and pensions. The gap constituted an inconsistency between pension fund and insurance companies that would make it expensive for pension funds heavily invested in equities to move their liabilities to an insurance company. As Speed argued:

In insurance, if you're holding safe assets, you need a certain amount. If I then want to move some of those assets, say, from gilts into equities, I need more capital. I need a higher capital buffer because there's more risk. Seems reasonable. Ask the question what happens in pensions, I'm holding bonds. If I go and hold equities, they say I need less capital. It's the wrong way round. (Speed interview)

The institutionalised discrepancies between the ways in which pension promises were evaluated between the two fields thus formed important barriers for the transfer of liabilities from pension funds to insurance companies.

A third factor shaping the 'playing field' between pensions and insurance were the mortality assumptions underpinning liability calculations. Actuaries in both pensions and insurance, as noted in chapter 5, would previously model mortality 'deterministically' – that is, mortality modellers would make 'prudent' assumptions about what future expected mortality rates would look like. In the early 2000s, however, British actuaries increasingly sought to quantify *how* uncertain such predictions were. The Continuous Mortality Investigation – a bureau run by the Institute and Faculty of Actuaries, which collects mortality data from insurers and pension funds and compiles mortality tables and projections – published an influential working paper in 2002. The paper claimed that recent improvements in mortality rates had been 'significantly faster than anticipated in the projection factors' of its latest publication of mortality tables in 1992 (CMI, 2002, p. 2).

In a canonical paper, the actuary Richard Willets (1999) had suggested that while mortality improvements had been more or less constant for most of the

eighteenth and nineteenth century, there had been a ‘cohort effect’ in the early 20<sup>th</sup> century. ‘For the past four decades, people born between 1925 and 1945 have benefited from faster mortality improvements than those born in adjacent generations’ (Willets, 1999, p. 5) – a generation that had now reached retirement age. The CMI thought the issue sufficiently pressing to update the projection factors of its 1992 tables ahead of schedule. At the time, interviewee DB recalls, ‘there weren’t any tools around to [model longevity improvements stochastically]’ and the committee ‘couldn’t develop one in time’. The committee nevertheless thought ‘it was important to try and give some impression of the uncertainty’ and therefore produced ‘a very simple approach where we had just three different scenarios of future mortality improvements’, each varying in the projected duration of the cohort effect (interviewee DB).

The paper was a ‘complete bombshell’, interviewee DB said. DB observed how the paper was received differently in the fields of pensions and insurance.

The life insurance companies thought: ‘well, hang on, there is a point here; there's a risk on our balance sheet because of our future longevity and it is uncertain, so there's uncertainty about the risk that we're facing; we'd better try to understand this and learn about it.’ So within the life insurance companies, they reasonably quickly actually developed quite a lot of in-house expertise. So now any of the major life insurance firms ... will be taking stochastic risk and uncertainty of the future of mortality into account. And Solvency II would require that anyway. But on the pension side they were just absolutely horrified. And they never came to terms with it, because the pensions actuaries in talking to their clients, they didn't want to present them with any uncertainty. They just wanted to say: ‘I'm the actuary, here's my calculation, that's the answer.’ And so they reacted with horror to having to consider any kind of uncertainty they might have to convey to a client. (Interviewee DB)

Interviewee DB suggests, in other words, that differences in the uptake of stochastic longevity modelling might be explained by looking at the structural position of actuarial expertise.

Even if pensions actuaries were relatively more sceptical of stochastic methods, however, the CMI paper suggested that longevity improvements had been structurally underestimated in prior decades. According to the 1992 projections, a

male at the age of 60 was expected to live another 22 years; in the CMI's 2002 medium cohort-length scenario, a 60-year old male was expected to live another 27 years (Jones, 2003). In 2008, the Pensions Regulator initiated a review of pension funds' mortality assumptions and noted that the 1992 medium cohort scenarios had already become outdated; the regulator suggested that the long cohort scenario would be more realistic, implying a further two-year increase to the life expectancy of a 60-year old male. Although supervisors acknowledged that different mortality tables might be appropriate for different schemes (as life expectancy may vary across occupations), they adopted the long-cohort scenario as a benchmark that could trigger further investigations into schemes' mortality assumptions. The consequences for pension funds' balance sheets were severe. The value of pension promises increased by three to four percent for each year that a worker was expected to live longer. For some companies, the liabilities could increase by as much as 15 to 20 percent (Cohen, 2008).

Crucially, the viability of the bulk annuity providers' business models depended also on the adjustments to what was understood as 'pure' market consistent valuation of insurers' liabilities permitted under Solvency II. Indeed, as discussed in the previous chapter, bulk annuity providers were amongst the most vocal proponents of adjustments in the discounting regime of Solvency II. To see why, remember that the valuation framework underpinning Solvency II requires insurers to value their liabilities at the risk-free discount rate, which should be similar (though not entirely the same since it is derived from swap rates) to the gilts rate. Thus, if an insurer would price a bulk annuity at a rate higher than the gilts rate, it suggests that it values the liabilities at less than the value of technical provisions in Solvency II. With the matching and volatility adjustment (discussed in chapter 7), the value of technical provisions, however, depends on the credit spread between the insurers' investments and the gilts rate too. The larger this spread, the lower the value of the assets needs to be to cover the liabilities. The larger the matching and volatility adjustments are, the higher bulk annuity rates can be relative to the gilts rate. The matching and volatility adjustments, in some sense, aligned the valuation of insurance liabilities more closely with that of pension liabilities.

To sum up, a convergence of regulations, a new accounting standard and stronger mortality assumptions all contributed to the levelling of the playing field between pensions and insurance. This was accompanied by the reframing of the differences and similarities between pension funds and insurance companies. Speed expressed this view as follows: ‘[T]he distinction between pensions and insurance is, to a certain degree, fallacious because we have two economic entities which are essentially doing the same thing. They are trying to pay pensions, as promised, to people with a very high degree of certainty’ (Speed *et al.*, 2008, p. 238). Any differentiation between the two fields, in other words, is simply due to the differences in the institutional features of the two adjacent fields – fields of which the functionalities overlap and that share the same internal governance unit in the form of the actuarial profession. Insurance companies, Speed suggested in addition, might well have a competitive advantage in managing those liabilities. Future ‘analysis of expenses,’ for instance, ‘could well tell us that ... insurance is actually a cheaper route for delivering pension promises ... because of the economies of scale which can be delivered’ (Speed *et al.*, 2008, p. 238).

#### *Making longevity risk liquid*

As the secondary market for pension liabilities emerged, so did the perceived need for another secondary market: one in which longevity risk could be traded. Although most actors agreed on the need for a separate mechanism to trade longevity risk, the motivations and opinions on the most appropriate way to do so diverged. For Rothesay Life, for instance, the ‘hedging’ or ‘reinsuring’ of longevity risk was an extension of its parent company’s standard *modus operandi*: ‘Goldman’s very much works on the basis that it wants to hedge all the risks that it’s running. For them, longevity was just another risk’ (Stoker interview). Another motivation, however, was akin to regulatory arbitrage (see chapter 7). With the introduction of risk-based capital, insurers are required to quantify their longevity risk and to hold capital against it, which could be rather substantial. This was especially true with the introduction of the ‘risk margin’ in Solvency II (as discussed in the previous chapter), which was intended to represent the market value of non-market risks but was widely considered to have failed to do so accurately. The additional capital need

for especially longevity risk provided an additional incentive for insurers to pass on this risk to third parties, which would allow insurers to free up capital that could be used, for instance, to underwrite new business.

The main strategy deployed by bulk annuity providers was to ‘reinsure’ at least some of the longevity risk with a ‘reinsurer’ – an insurance company for insurance companies (Jarzabkowski *et al.*, 2015). Since the inception of the bulk annuity buyout market, however, there have been sustained attempts to design alternative, market-based instruments for trading longevity risk. Reinsurance solutions are highly customised, limiting the range of investors who are willing to invest in it. To facilitate the ability of insurers and pension funds to take longevity risk off their books, proponents of market-based solutions argued, it was necessary to draw on capital market participants by offering standardised instruments for trading longevity risk. Indeed, as economic sociologists have pointed out, making an object tradable requires the creation of ‘generalised’ risk knowledge (Carruthers and Stinchcombe, 1999, p. 356). ‘To construct a market transaction’, Callon (1998, p. 19) similarly asserts, the object being traded ‘must be decontextualized, dissociated and detached.’ In short, the commodity must be homogenised – a homogeneity that is most durable when the object or commodity has undergone processes of standardisation (Çalışkan and Callon, 2010).

While standardisation may be an important aspect of making a market, too much standardisation may mean that the commodity being traded loses its utility for those buying the commodity. There was, in other words, an important trade-off to be made in the design of longevity instruments, proponents of market-based solutions noted.

... a well-constructed hedge programme must perform a delicate balancing act to be effective. On the one hand, it must provide an exposure that sufficiently mimics the performance of the underlying portfolio so as not to introduce unacceptable amounts of basis risk; while, on the other hand, it must simplify the modelling and underwriting process to a level that is manageable by a broad base of investors. Further, the hedge transaction must compress the 60+ year duration of the underlying retirement obligations to an investment horizon that is appealing to institutional investors. (Michaelson and Mulholland, 2014, p. 21)

The viability of longevity risk as a financial market commodity, as suggested by Michaelson and Mulholland, thus depends on the construction of knowledge machinery that: 1) compresses the temporality of long-term insurance products into a time horizon aligned with that of prospective buyers, and 2) simplifies the evaluation of risk, whilst, at the same time, providing a good match for insurers and pension funds' idiosyncratic longevity risk.

Central in the strategy of proponents of market-based solutions were stochastic models to quantify longevity risk. Most notable are the models produced by Andrew Cairns, a professor of actuarial science at Heriot-Watt University, who is regarded as a pioneer in the field of longevity modelling. Cairns spent the early years of his career on interest rate modelling, repurposing models from modern finance theory for actuarial use. When Cairns started modelling longevity risk, a direction that was suggested to him by the director of the Pensions Institute, David Blake, he 'just blazed on' and did his 'own model[ing] before reading about the more classic work from ten years earlier by Lee and Carter' (Cairns interview; on the Lee-Carter model, see chapter 6). In his first longevity model, Cairns sought to project forward the 'instantaneous rate of mortality', or 'force of mortality', which, he argued, could 'be treated in a similar way to the short-term, risk-free rate of interest' (Cairns, Blake and Dowd, 2004, p. 1).<sup>39</sup> His model, which he thus derived from the analogical extension of his earlier work on interest rate modelling, 'quickly got the attention of people in industry', Cairns recalled, 'much more so than the interest rate model' (Cairns interview). In subsequent years, Cairns' longevity model (in its continuously updated form) would form the basis for measuring and pricing longevity risk.

In the mid-2000s, various banks, insurers and reinsurers started experimenting with different configurations of market-traded instruments to see if they could generate sufficient interest from both the 'demand' and 'supply' side of longevity risk (Blake *et al.*, 2013; Blake, Cairns and Dowd, 2019). The European Investment Bank and BNP Paribas, for instance, experimented with the issuance of longevity

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<sup>39</sup> As Cairns noted, however, 'there were limits to how far you could go with that analogy' (Cairns interview). Nevertheless, the interest rate analogy provided the starting point for his own longevity modelling work.

bonds, providing its buyers with 25 annual coupon payments, the size of which would be directly proportional to a ‘survivor index’ of a reference population (Brown, 2004). Similarly, Lucida and JP Morgan issued a ‘q-forward’ contract, the value of which would depend on the difference between a fixed mortality projection and actual mortality experience of a reference population (Coughlan *et al.*, 2007). To facilitate transactions like these, various actors (notably investment banks) started offering longevity indexes, such as JP Morgan’s Life Metrics, that could be used as a reference rate for index-based contracts like these.

The success of these instruments, however, remained rather limited. Whilst the EIB’s longevity bond was discontinued, JP Morgan struggled to find investors to take the longevity risk. From the perspective of the potential buyers of protection, the risk commodity had become *too ‘detached’*. Buyers, as a consequence, remained stuck with ‘basis risk’ – the risk that mortality experience in the reference population would differ from the mortality of the population for which the buyer sought protection. For insurers and pension funds, however, longevity protection is ‘all about managing down ... capital requirements’ (Cairns interview). Even if an instrument would provide some protection against longevity risk, the advantages of the instrument would thus remain limited if the protection did not translate into ‘capital relief’. For regulators, the existence of basis risk remained problematic, which limits the potential of index-based instruments as providers of capital relief. Unsurprisingly, ‘basis risk’ became an epistemic object – an object that proponents of index-based solutions seek to describe, quantify and manage.

Whilst the success of market-based instruments remained limited, another type of instruments did become increasingly widespread: longevity swaps (see figure 8.1). In a longevity swap, the party buying protection (the pension fund or insurer) promises to pay its counterparty (typically, though not always, a reinsurer) a fixed set of payments based on a best-estimate projection of its liabilities *plus fees*. In exchange, the counterparty promises to pay the actual benefits that a pension fund or insurer owes its members or policyholders. Longevity swaps are thus highly ‘bespoke’; they require insurers and reinsurers to perform a detailed analysis of the underlying portfolio of pensioner annuities. However, as the broker/consultant

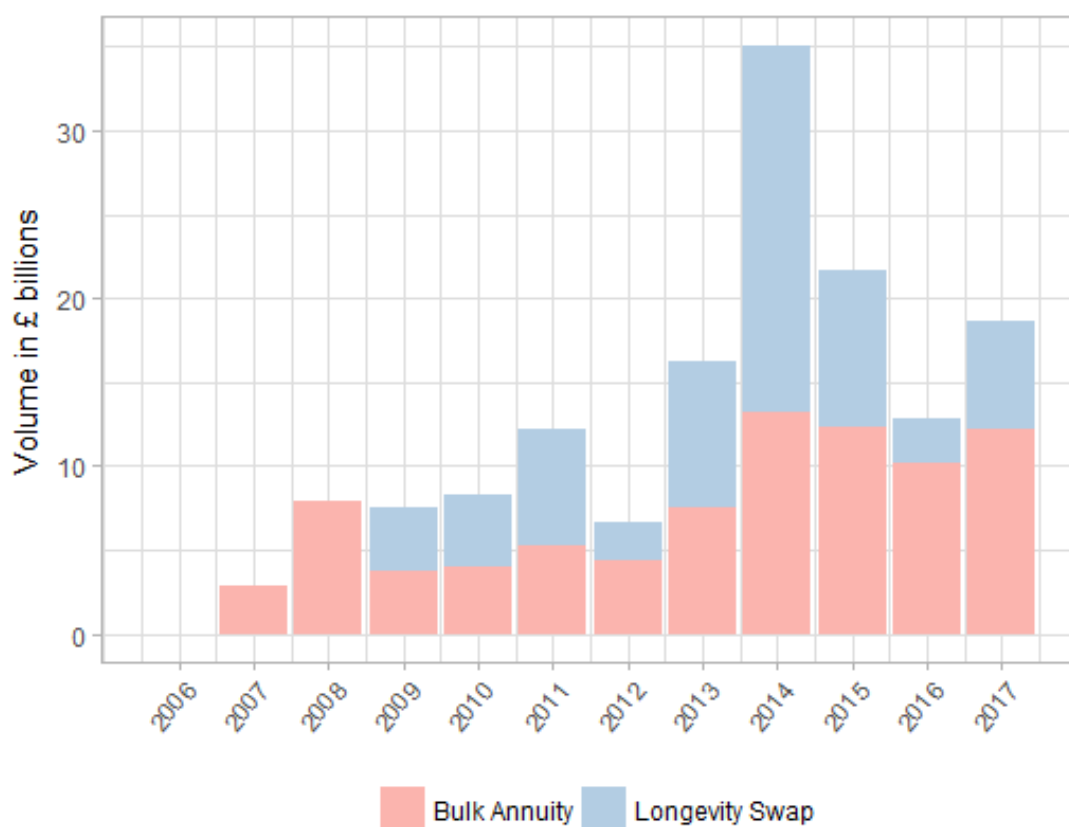
Tiziana Perrella explained, the market for longevity swaps has ‘grown enormously ... in standardisation over a short period of time’ (Perrella interview).

Although the longevity swaps that are written now are fairly bespoke, there is a clear understanding as to what the product does and, at a high level as to how it should be administered. And then you work around some quirks around that menu if you like of potential choices. (Perrella interview)

One of the ways in which longevity swaps were standardised was that broker/consultants started offering platform-like services that ‘streamlined’ the preparation process. Apart from standardisation, the market also had grown in ‘sophistication’, according to Perrella. A typical longevity swap transaction would be intermediated by an insurer, allowing a pension fund to ‘access’ the balance sheet of a reinsurer. Since 2014, however, broker/consultants like Willis Towers Watson, PWC and Mercer started offering pension schemes to use an ‘incorporated cell company’ based in Guernsey to pass on the longevity risk directly to reinsurers without the need for intermediation by insurance companies or investment banks.

Although longevity swaps were considered to provide pension funds and insurers with fairly well-matched protection against longevity risk (even if it introduces new risk, like ‘counterparty exposure’ to the provider of the swap), they did not provide a ‘capital markets solution’ favoured by those looking to expand the supply of longevity protection. Longevity risk thus increasingly ended up on the books of a relatively small number of reinsurance companies that were situated at the end of a sometimes rather long chain of intermediation. Even if current levels of concentration were not yet problematic, further amassing of longevity risk on these balance sheets might increasingly become so, Andrew Bulley (2016a) suggested in one of the speeches referred to at the start of this chapter. In April 2016, £150bn of defined benefit liabilities had already been transferred to insurance companies; total liabilities of defined benefit pensions in the UK, however, amount to £1.8trn, with annual transaction volume between £10bn and £30bn since 2014 (Rule, 2018, 2019).





**Figure 8.1** Transaction volume in the bulk annuity and longevity swap market. The data excludes transactions among insurers. Source of data: Willis Towers Watson (2019).

### *The price of a buyout*

A crucial aspect of any market is the price discovery mechanism. In financial markets, quantification of the risk-reward trade-off plays an important role in structuring the price discovery process, even if prices may be affected by various non-quantifiable factors. Indeed, option-pricing theory contributed to the success of options trading because it established a mathematical relation between the risk and pay-off of an option, which helped frame derivatives as legitimate risk management instruments (MacKenzie and Millo, 2003). The modelling of financial instruments is a means to represent potential future outcomes, and thereby to provide an indication of and to inspire confidence in the value of an instrument (cf. Svetlova, 2018b). Quantification, however, is not all there is to a price discovery mechanism. Such processes are also influenced by the structure of the market: how deals come about

and how power differentials among actors may pull the price discovery mechanism in their favour.

The trading of pension risk, whether in the form of a bulk annuity buyout, buy-in, or a longevity swap, is intermediated by firms that play the dual role of broker/consultants: they advise pension schemes on bulk annuity transactions and at the same time intermediate between buyers and sellers. As Tiziana Perrella, who is an experienced broker/consultant of bulk annuity transactions explained, ‘being a broker is a by-product of me being a consultant... Once you get to the broking stage, that’s the easier bit. It’s the preparatory work that is the complicated bit’ (Perrella interview). Indeed, the construction of a deal can be a rather lengthy affair.

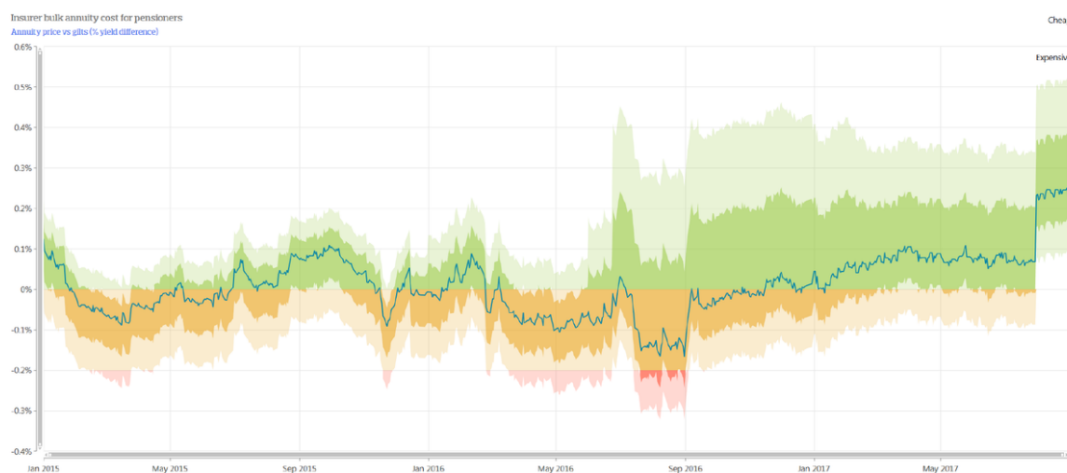
...from the first meeting that we have with the trustees – just explaining what bulk annuity is – to actually then completing a transaction can easily be years. Sometimes ... they want to move quickly ... and we can complete the transaction in a matter of say six months. (Perrella interview)

Much of this time is spent on preparatory work: the collection and ‘cleansing’ of data such as postcode information and information on spouses, and a legal review of the ‘benefit specifications’. Once the relevant data have been obtained, the broker/consultant will assess the types of transactions that are ‘feasible’, to see, for instance, whether a scheme is sufficiently funded for a full buyout, or, if not, whether it has access to alternative funding or whether an alternative solution such as a buy-in or longevity swap would be preferable.

If the broker/consultant and scheme trustees decide that a full buyout is feasible, they will ‘then try to derive a yield that would be acceptable’ (Perrella interview). The price of a bulk annuity transaction is expressed as a spread over the interest rate on gilts, or UK government bonds (e.g. gilts plus 50 basis points). As Perrella explained, this is because ‘you can look at bulk annuity a bit like a gilt, but it’s a better gilt, because it matches your longevity’. A bulk annuity, in other words, can be seen as an investment that yields a constant stream of payments, not, as in the case of gilts, at a constant coupon rate, but at a rate that perfectly matches the payout to pensioners. The bulk annuity rate thus depends on underlying assumptions about

how large future pensioner benefits will be. If the bulk annuity rate ‘looks like gilts plus, great. If it looks like gilts minus, not so great’ (Perrella interview).

An important aspect of the orchestration of the buyout transaction is the apparatus that visualises the market (cf. Knorr Cetina and Bruegger, 2002). The bulk annuity providers feed price quotes (expressed as ‘gilts +/- X basis points’) to broker firms, which then construct a price curve to visualise ‘what the market is looking like’ (Perrella interview; see figure 8.2). If a quoted price is too far off the ‘target price’, the broker might advise the scheme to wait. If the broker/consultant thinks that ‘the pricing also works based on the evidence that we’ve seen in the market’, the transaction will proceed to the next phase. Thus, in a way, the broker/consultants serve as ‘gatekeepers’ to the ‘market place’ in order to balance the supply and demand for bulk annuities.



**Figure 8.2** A graphic representation of the price evolution of bulk annuities. The green area indicates a bulk annuity rate higher than the current gilts rate; the amber area indicates a rate between the gilts rate and 20 basis points below the gilts rate. The red area indicates a price higher than 20 basis points below the gilts rate. Source: Aon.

The price quotes, however, are generic quotes and do not refer to any specific book of liabilities. This is where the insurer’s modelling apparatus becomes important: the insurer takes the pension scheme’s data and models the future benefits of the scheme using its own best estimate assumptions of things like future mortality. The insurer then models ‘the capital that you’re required to hold against those

benefits' (Stoker interview). This, again, will differ across companies: whilst some companies calculate their capital requirements using the standard formula provided by Solvency II, other companies use their internal capital model. The insurer then does 'a calculation to say what return do I need to make on the capital, and, therefore, what premium do I need to charge for it' (Stoker interview). The competing insurers then simply give the broker a price for the liabilities that they are willing to take them on for. 'And then it's our job and the trustee's job to work out whether that 100m looks reasonable, cheap or expensive', Perrella said.

In the bulk annuity market, the price of a transaction is determined mainly through the competition among insurers and is structured by the epistemic machinery and regulatory requirements. Pension funds have little influence on the price formation process and are generally 'price takers', Speed suggested. When a pension trustee agrees with the management of the scheme sponsor to take the scheme to market, the decision to buy out the scheme has already been made. This is also influenced by the motivation to initiate a buyout procedure. Companies may, for instance, perceive pension funds as a 'barrier' to corporate strategy, e.g., when it seeks to merge with or acquire other companies, or when it intends to split off parts of the business, 'so you have to deal with pension schemes to allow business to progress and do things'. For most companies, buyouts are about 'affordability', Speed said: 'sometimes you get a sponsor who says: if you can get it off balance sheet and I have to pay less than X to do it, I'm just happy to do that' (Speed interview).

## Competing in the 'New Life Market'

In the preceding section, I showed how the emergence of the buyout market was facilitated and shaped by the framing of insurance companies and pension funds (and the differences among them) and the concomitant changes in the regulatory treatment of pension schemes, the emergence of conduits for passing longevity risk to reinsurance companies, and the establishment of pricing conventions. This section describes how the structure of competition within the market evolved.

In the years preceding the financial crisis, there were strong competitive pressures among insurers participating in the buyout market. The new, ‘monoline’ bulk annuity providers sought to challenge the privileged status of the incumbent insurers by undercutting their pricing. For the challenger firms to become viable, they needed ‘scale’. Anecdotal evidence suggests that competitive pressures amongst participants in the buyout market were strong. The challenger firm Synesis Life, for instance, failed to sell a single bulk annuity (Essen, 2008). Others pursued rather aggressive acquisition strategies. Pension Corporation, for instance, acquired several companies with the intention to replace their pension scheme’s trustees with its own directors and to strip off the company’s pension liabilities before re-selling the company’s other assets (Davies, 2009).

In late 2007, Pension Corporation’s acquisition strategy met with regulatory resistance. When the challenger firm acquired the telecoms company Telent, the latter’s pension trustees registered their concerns with the Pensions Regulator that the takeover would lead to ‘conflicts of interest’ (Bandel, 2007). The company, which had in 2006 been split off from the Marconi Group, which was itself being acquired by Ericsson, held claims on a £490mln escrow account as a provision for future shortfalls in the pension scheme; the trustees of the scheme worried that Pension Corporation was after this sum (Davies, 2009). The Pensions Regulator decided to intervene and appointed three independent trustees to the scheme. Even if Pension Corporation did eventually come to an agreement with the regulator about the contributions that it would make to the fund, the regulatory challenge had made the company wary of the acquisition strategy.<sup>40</sup> Indeed, Pension Corporation refrained from buying companies. The regulatory intervention, in other words, had set limits to the strategies that the new buyout firms would pursue.

By late 2008, moreover, competitive pressure started to decline, which was partly due to consolidation. In some cases, the consolidation was a direct consequence of the financial crisis. Due to the widening spread between corporate

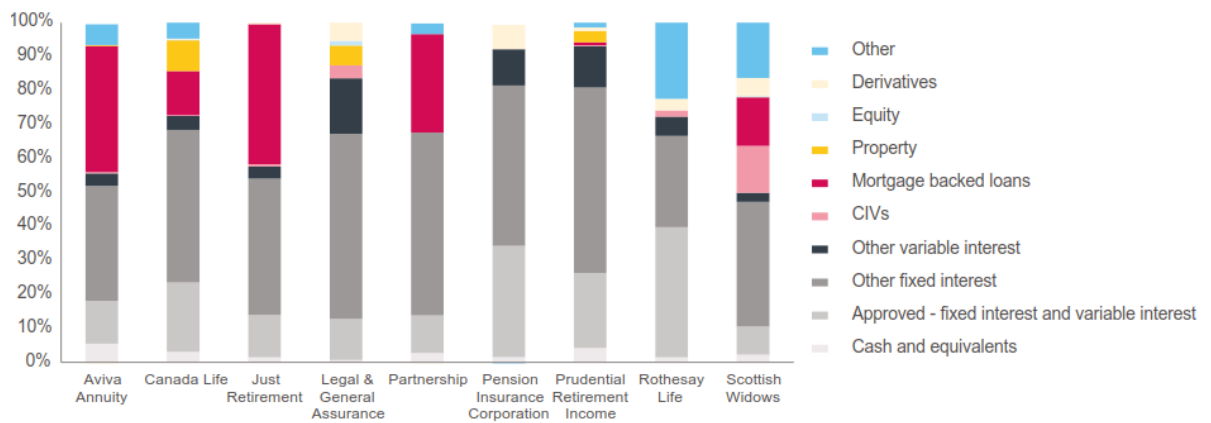
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<sup>40</sup> The CEO of Pension Corporation, Edmund Truell, however, argued, based on the company’s own modelling, that the company’s pension scheme was underfunded, even when including the sum held in the escrow account (Davies, 2009).

bonds and the risk-free rate (see chapter 7), for instance, regulatory capital requirements for bulk annuities increased substantially. For Paternoster, this meant trouble. The company was unable to raise new funds from its investors and subsequently stopped writing new business. The company was later acquired by Rothesay Life, who paid half of what the original investors had put in it (Davies, 2011a). Similarly, Lucida stopped writing new business due to capital strain and was later bought by Legal & General. In other cases, the consolidation was more directly related to competitive pressures. Pension Corporation, for instance, acquired Synesis Life, which, as noted above, had failed to sell a single bulk annuity.

The structure of competition in the buyout market was also influenced by institutional changes in the market for retirement income more generally. In 2014, for instance, George Osborne, who was chancellor of the exchequer then, announced new plans to grant pensioners ‘new freedoms’ by allowing them to convert (part of) their pension savings in cash rather than an annuity (which had up to that point been mandatory). When the new freedoms were implemented in 2015, this caused an immediate drop in the sales of individual annuities. In an attempt to sustain their annuity business, traditional annuity providers like Scottish Widows and Canada Life entered the bulk annuity buyout market. Similarly, in anticipation of the reforms, Partnership and Just Retirement merged to form JRP Group and started competing more aggressively in the buyout market too. Prudential, in contrast, decided to stop writing annuity business altogether. In the early years of the market, the incumbent had already been ‘selective’ in its deal-making, refusing to participate in strong price competition. (As a result, the company had written no new bulk annuity business for some time between 2010-2013). With Osborne’s pension reforms, it did not seem that the profitability of the old buyout market would return.

Various mechanisms allowed participating firms to avoid direct competition (Fligstein, 2001). One mechanism was that of product differentiation. Although it might seem that a bulk annuity is a relatively homogeneous product, in practice this is not the case. An important aspect of product differentiation is ‘insurers’ ability to access specific assets’, Perrella noted. When specific investment opportunities arise, these may translate into ‘pricing opportunities’ (Perrella interview). Even in the case

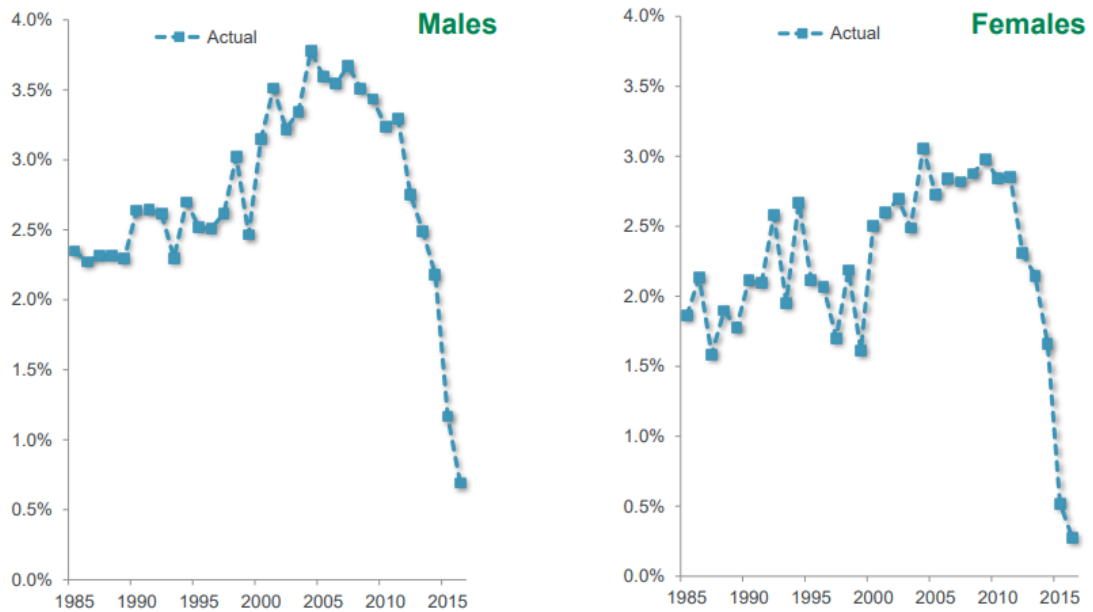


**Figure 8.3** Asset allocations of bulk annuity providers. Source: Hymans Robertson (2016).

of a full buyout, when the insurer receives both the liabilities *and the assets* from a pension scheme, it will seek to re-invest the assets in a way that it thinks better matches the liabilities. This process, as Speed explained, can be rather hectic, and thus influences the willingness of an insurer to price competitively.

In insurance, you have the case where you must be solvent, which includes having enough money and dealing with your value at risk on a continuous basis, at least every day. So you measure that. That's comparatively easy in the steady-state. But then imagine a transaction where you have a new liability that hits your balance sheet with a load of assets, which materially increases your asset-base and those assets aren't necessarily in the right shape. You've got one day to put that into the right position. That's pretty challenging. Getting all that executed, going through a process trying to make sure you're getting best value for money, you've got good execution, all that is consolidated, so that by the close of the play you can go and stand in front of the regulator and say: yep, that's all I executed. We've hedged our liabilities, we know where we are, and we can survive all those shocks. (Speed interview)

One way in which competition between insurers is regulated is the differentiation of investment strategy. Figure 8.3, for instance, provides an indication of the degree of differentiation of insurers' investment strategies. As opportunities for specific types of investment arise at different moments, different insurers may be able to quote competitive prices at different times.



**Figure 8.4** Average annual improvement rate over the previous 5 years, 1925-45 birth cohort, England & Wales (Gordon *et al.*, 2017).

Apart from investment strategy, there were other factors shaping competition among insurers too. One is, for instance, the size of the schemes that buyout providers are willing to take on. While AVIVA, Canada Life and Just Retirement aim specifically for relatively small schemes (up to £500m), Rothesay Life and PIC aim specifically at larger schemes (no smaller than £100m). Another important factor is whether an insurer focuses on mortality or investment-related risk. While established insurers tend to focus on mortality risk and may have access to underwriting capacity, offering the possibility to conduct medical surveys, the new entrants tend to focus on operational efficiency and investment. Paternoster, for instance, performed most of its modelling and back-office work in India (Northedge, 2008). Thus, the position of insurers in the buyout field is partially shaped by the access that they have to the knowledge machinery of a traditional life insurance operation and whether they have access to specialised investment management.

While the financial crisis showed the importance of expectations surrounding insurers' ability to source capital and high-yielding assets, the post-2014 decline in market volume indicated the significance of quite another sort of expectation: that of life expectancy. 'The market is only going to be active', Perrella explained, 'if there



isn't a significant disconnect between the consultants, the trustees and sponsors' view of longevity versus the insurers and reinsurers' view' (Perrella interview). By the early 2010s, however, it appeared that the pace of mortality improvements had declined substantially, bringing back to the fore the question of how future mortality improvements should be modelled. The issue was debated in a meeting at the Staple Inn Actuarial Society, where there was a 'high turnout ... with some having to stand', Jon Palin (2017), a member of the CMI Mortality Projections Committee observed. 'There seems to be a growing consensus that we have seen a genuine slow-down in general population mortality improvements rather than just a blip.' At the meeting, the actuary who had introduced the concept of the 'cohort effect' nearly two decades earlier, Richard Willets, illustrated the slow-down dramatically with a graph depicting historical mortality improvements for both males and females (see figure 8.4). The drop in mortality improvements, Willets suggested, could be seen as a reversion of historically more typical 'rates of change' and could be linked to 'the impact of economic austerity' (Willets in Gordon *et al.*, 2017). This 'reversion' added significantly to profit expectations of business written in preceding years. In March 2019, just four insurers announced £1.5bn in profits with expectations of future profits exceeding £2bn (Ralph, 2019).

As the trend started to change in the post-crisis years, a 'disconnect' emerged between pension funds' and insurers' expectations of future mortality improvements. While pension funds (and particularly the consultants on which they relied) started to believe relatively early on that the trend was reversing, insurers and particularly reinsurers (with whom the longevity risk ultimately ends up) were more sceptical, suspecting that the dramatic changes in mortality improvements were simply a 'blip'. However, once the consensus emerged in the epistemic field that longevity improvements were a structural trend, and the CMI had published an updated model of future longevity improvements, mortality expectations started to converge. Insurers also got increasingly 'comfortable' with Solvency II and started to develop enhanced capabilities to 'source higher-yielding assets' eligible for the matching adjustment (Perrella, personal communication), which provided an impetus to the volume of trades in the bulk annuity buyout market (see figure 8.1). With £2trn of

defined benefit liabilities, many expect this to be just the start (e.g. Willis Towers Watson, 2017).

## Conclusion

To conclude, four ways in which the evaluation machinery was entangled with or shaped the field of retirement income can be distinguished. First, modern finance theory's notion that instruments generating similar cash flows should also be valued similarly contributed to the perception that there is no economic difference between a pension liability on the balance sheet of an insurance company and a pension scheme, thereby reducing the perceived significance of institutional boundaries between the two fields. Market consistency thus paved the way for the transfer of defined benefit liabilities to insurance companies. Second, changes in the knowledge machinery shifted attention towards the market value of liabilities, while previous actuarial calculations had been geared towards questions of 'funding' (e.g. the question of what the level of employer and employee contributions should be to meet *expected* liabilities, not the market value of those liabilities when selling them to a third party today). Third, the development of stochastic longevity models allowed for the quantification and pricing of longevity trend risk and thereby facilitated the transfer of 'longevity risk' to the balance sheets of reinsurance companies located in offshore financial centres. Furthermore, Solvency II – and the risk margin in particular – incentivised the transfer of longevity risk. Fourth and finally, the extent of competition in the buyout market is affected by changes in mortality expectations and the differential access that insurers have to knowledge machinery that allow, e.g., medical underwriting or that are capable of performing specialised credit assessments.

The above analysis of the emergence of the bulk annuity buyout market has further shown that changes in insurers' and pension funds' knowledge machinery were consequential. Although it is difficult to assert causality, the increased prevalence of market-consistent valuation practices, and the concomitant changes in regulation, investment practice and longevity modelling all contributed to reshaping the political economy of retirement. At the core of this is the replacement of an

employer covenant as the backstop for pension risk with the risk-based capital of an insurance company. This shift of responsibility for managing pensions to ‘private financial services providers’, some of whom may see bulk annuities as a cheap source of funding for direct lending (Rule, 2019), is part of a broader set of developments that some refer to as the financialisation of pensions (Hassel *et al.*, 2019). Yet, this chapter also presents an important caveat to tendencies to perceive such developments as part of a single process of financialisation. While the analogical extension of modern finance theory to the domain of pensions contributed to framing pension funds as ‘mini insurance companies’, the viability of the bulk annuity market also depended on adjustments to the market-consistent framework of Solvency II that were regarded as compromising its ‘theoretical purity’.



# Chapter 9

## Conclusion

The way in which life insurance companies deal with uncertainty has changed significantly since the 1970s. Prior to the 1970s, insurers focused mainly on the making of ‘diversifiable risks’: the pooling of individual lives to create more or less stable outcomes on aggregate. Any remaining uncertainty was dealt with through the twin mechanism of actuarial prudence and discretion. The mechanism for dealing with uncertainty in contemporary life insurance is quite different. Insurers now quantify not only diversifiable but also non-diversifiable risks, such as market risk and longevity risk. Accordingly, the mechanism of actuarial prudence and discretion is replaced by market-consistent valuation and risk-based capital. There are two ways of looking at this shift. On the one hand, it is possible to look at the evolution of techniques and methods that insurers use to evaluate their insurance liabilities. On the other hand, we may focus on broader developments in the life insurance market, such as changes in the structure of contemporary life insurance arrangements, and its adjacent fields, such as increased financial market volatility and the increased use of structured financial products in the field of professional investment. The question that I set out to address in this dissertation is *how* these developments were related.

The field-theoretical perspective developed in chapter 2 (which adopts an ‘endogenous’ understanding of technology and law) allowed me to address this question by focusing on the strategic behaviour of relevant actors. It is possible to distinguish three ways of understanding the interrelation between the market and the epistemic field. First, challenges to and changes in the dominant structure of the market field may provide an impetus to developments in the epistemic field. In chapter 3, for instance, I argued that the emergence of unit-linked insurance (an invention by ‘challenger’ firms to undermine the strategic advantages of traditional life insurance companies) led to the emergence of ‘financial risk’ as an epistemic object in actuarial science and its explicit quantification with mathematical tools that

were theretofore ‘foreign’ to the field of actuarial science. Similarly, I suggested in chapter 5 that the declining epistemic and supervisory authority of the actuarial profession (at least partially a consequence of the Equitable Life debacle) contributed to the ascendancy of market-consistent valuation as the dominant paradigm in the epistemic field. In some cases, the influence was more subtle. In chapters 7 and 8, I argued that the politics surrounding Solvency II turned ‘liquidity risk’ and ‘longevity risk’ into epistemic objects in the actuarial field. The point here is not that the structure of the epistemic field is entirely determined by the structure of the market field. Rather, it is to suggest that developments in the market field may act as a social force in the epistemic field, which: 1) creates hierarchies among paradigms by providing new opportunities for actors in the epistemic field to form coalitions with actors in other professional ecologies, 2) opens up research in some objects and not others, and 3) shapes the epistemic toolkit that may be used to frame and solve problems.

Second, developments in the epistemic field provide resources and constraints for strategic behaviour in the market field. The emergence of asset-share methodology as described in chapter 4 influenced the bonus policies of with-profits funds and ultimately reduced actuarial discretion in conventional insurance. Another example may be found in chapter 8, where I argued that changes in evaluation practices facilitated the perception of pension funds as ‘mini-insurance companies’, thus reducing the barriers between the market fields of occupational and private pensions. Similarly, the introduction of market-consistent valuation and risk-based capital calculation further entrenched the decline in actuaries’ epistemic authority by shifting responsibility for judgment about the credibility of insurers’ profit expectations to shareholders, whose evaluations are aided by modelling practices that are seen as objective (chapter 6). The exemplars that are central in the epistemic field, in other words, function like an institution that may operate as a ‘social force’ in the market field, structuring the relations among actors and shaping its boundaries.

Third and finally, developments within the market field may affect the boundary between the epistemic field and the market field. The clearest example of this can be found in chapter 7, with the introduction of Solvency II. For EU

regulators, market-consistent valuation and risk-based capital calculation were perceived as useful strategic resources for harmonising regulation across member states. The ostensible objectivity of market-consistent valuation and risk-based capital calculation endowed such efforts with the legitimacy needed to overcome the obstacle of competition politics. When these practices became institutionalised, however, boundaries between the epistemic field and the market field started to fade. In the specification of new rules, both epistemic and pragmatic considerations explicitly played a role. With the institutionalisation of evaluation practices, in other words, considerations that were previously considered to belong to distinct fields became conflated in a process of translation, from a set of exemplary problem solutions to a detailed set of rules.

## Implications and Contributions

The story presented in this dissertation (and as summarised above) is essentially one of ‘coproduction’ – a narrative structure that is prevalent in science and technology studies and indeed in the social studies of finance. In science and technology studies, the term is adopted to point to the mutually constitutive character of scientific knowledge on the one hand, and ‘nature’ and ‘society’ on the other. Sheila Jasanoff usefully summarises this view as follows:

Briefly stated, co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it. ... Science, in the co-productionist framework, is understood as neither a simple reflection of the truth about nature nor an epiphenomenon of social and political interests. Rather, co-production is symmetrical in that it calls attention to the social dimensions of cognitive commitments and understandings, while at the same time underscoring the epistemic and material correlates of social formations. (Jasanoff, 2004, pp. 2–3)

The performativity thesis (as discussed in chapter 2) is in a sense a particular variation of the co-productionist narrative; it focuses on the mutual constitution of socio-technical practices and the economy. In this dissertation, I have sought to take such a perspective further by investigating how we may integrate it with field-theoretical approaches in economic sociology that focus on strategic behaviour to

explain the creation and sustenance of meso-level social orders. This approach allows me to make three further contributions to contemporary debates in the social sciences: the political economy of evaluation, the individualisation of risk, and the influential role of key exemplars in modern financial economics in shaping markets. Each will be taken in turn.

### *The political economy of evaluation*

The first contribution of this dissertation is to further our thinking about the link between issues of political economy and evaluation practices. As this study has shown, evaluation is not simply a technical affair. Much may be at stake in evaluation, particularly so if particular practices acquire institutional force. How insurers evaluate insurance liabilities matters for the structure of the products that they sell and how they behave as participants in capital markets. In this dissertation, for instance, we have seen that changes in insurers' evaluation machinery contributed to: 1) changes in the structure of contemporary life insurance arrangements, 2) a reduced willingness to provide long-term insurance; and 3) a shift in investment strategy, away from equities and towards derivatives and fixed-income investments, including forms of 'direct lending'. Because they are consequential, evaluation practices may give rise to conflicts that are sometimes rather manifest and the object of 'overt' politics. This was the case, for instance with Solvency II, where differing opinions about the appropriate application of particular concepts gave rise to political negotiation and, eventually, political compromises. More often, however, evaluation practices are subject to a form of 'covert' politics in which tensions among different stakeholders play out on a subterranean level, hidden beneath technical vocabulary.

Central in the political economy of evaluation practices in the context of insurance is the discounting regime. The long-term nature of insurance liabilities means that the choice of the discount rate will likely have an important impact on the value of insurers' assets and liabilities. Discounting, as Derringer (2017) shows, is a long accepted technique to transform future cash flows into a 'present value', but has itself a history of contestation. Although the technique of discounting is now widely accepted, contestation remains about *how* the relevant discount rate should be determined. In the case of insurance, this manifested itself in the debate about how



the risk-free curve should be constructed, which had differential implications for the different European insurance industries and the viability of the products that they sell.

The relevance of this perspective to other domains became clear during my research for this dissertation. The recent pensions dispute in UK higher education and the proposal to turn the Universities Superannuation Scheme into a defined contribution scheme provides another example of the political dimension of the economic evaluation of long-term financial promises. While Universities UK, the organisation representing university management boards, claimed that the defined benefit pensions had become too expensive, the labour organisation, the Universities and Colleges Union argued that the calculative methods used by the scheme's actuaries were too stringent, making the pension promises seem more expensive than they really were. The dispute, then, underlines the following point: discounting regimes are a fundamental aspect of the political economy of long-term financial promises such as those entailed in insurance and pensions; they may benefit some stakeholder groups over others and those affected will thus have an incentive to attempt to move the rules in their favour. The choice of discount rate involves a choice about the appropriate distribution of benefits and risk among the stakeholders in long-term insurance arrangements. In the world of insurance as well as pensions this has led sometimes to manifest but often subterranean conflicts about seemingly technical affairs.

Another way in which evaluation practices may be related to issues of political economy is that (as already noted) they contribute to creating, maintaining and sometimes eroding boundaries between fields. In chapter 8, for instance, I argued that the convergence of evaluation practices in the field of life insurance and occupational pensions contributed to the perception of pension funds as being similar to insurance companies, thus paving the way for the transfer of pension liabilities from defined benefit pension schemes to insurance companies. At the heart of this transfer, I argued, is an issue of political economy that is not frequently discussed: a change in the mechanism with which pension promises are secured from one based on the relation between the scheme sponsor and the scheme itself to the mechanism

of risk-based capital, which is characteristic of private insurance. This, in a way, is part of a broader development that may be referred to as the ‘privatisation’ of pension promises (cf. Hassel *et al.*, 2019). It is not so much to say that in these new arrangements pension promises are by definition less secure: rather, it is to say that the nature of the relation between the sponsor and its pensioners is different. This leads me to another related issue: that of the individualisation of risk.

### *The individualisation of risk*

The phrase ‘individualisation of risk’ in the context of finance is often used to denote the shift from defined-benefit to defined-contribution pensions in the UK and elsewhere (Langley, 2004, 2006, 2008; Berry, 2016) – a topic that was hotly debated in the context of the Universities Superannuation Scheme too. In the case of defined benefit pensions, employees receive a guaranteed retirement income, defined as a percentage of their final salary or average salary. The burden of uncertainty is placed on the sponsor (which may have to increase its contributions), not on the individual worker. In the case of defined contribution pensions, this is turned upside down: the contributions are set, and pension benefits are contingent on the performance of investments made by the worker, either consciously or by default. Hence, the individualisation of risk.

In this dissertation, we have seen that a similar shift has taken place in life insurance arrangements. In traditional with-profits arrangements, policyholder benefits were not directly contingent on financial market performance but are determined through bonus policies that are intended to ‘smooth’ policyholder benefits across different generations. This was done with an ‘estate’ or the assets that belong to the company as a whole, but to no policyholder or shareholder in particular: in good times, the company would add to its reserves; in bad times, it would take from them. The company as a whole, not individual policyholders, carried the burden of short-term uncertainty. This structure is inverted with unit-linked insurance, which, as displayed in figure 4.1, has become the dominant line of business in the UK: policyholder benefits are directly tied to financial market performance and any financial guarantees are charged for separately, like financial options. Insurance contracts have become increasingly similar to portfolios of

financial instruments, in which the cost of financial risk is directly charged to the individual.

While most studies of the individualisation of risk see it as the result of a ‘neoliberal governmentality’ (O’Malley, 2002, 2012; Dean, 2010; Rose, 2017), the story in the context of private insurance arrangements appears slightly different. Here, the individualisation of risk was explained as the outcome of competitive dynamics and strategic behaviour, notably incumbent insurers’ response to the challenge of unit-linked insurance. While unit-linked insurance remained initially relatively marginal compared to conventional insurance arrangements, the latter nevertheless responded to the challenge of unit-linked insurance by appropriating some of its methods and techniques. This, however, reduced insurers’ discretionary space in bonus policy (once insurers used asset-share methodology as a guide for their bonus policy, it was difficult to argue that policyholders’ benefits should be any different from their asset shares), which sat uncomfortably with the traditional way of dealing with financial uncertainty through actuarial prudence. Conventional insurance, in other words, increasingly started to look like unit-linked insurance, placing financial market risk increasingly at the level of the individual. New ways of evaluating insurance policies thus operated as a force in the market field, first providing challenger firms with resources to challenge conventional insurance arrangements, then exercising an isomorphic force over unit-linked and conventional insurance (cf. DiMaggio and Powell, 1983).

The individualisation of risk is at the root of the ‘identity crisis’ mentioned in the introduction to this dissertation. With the explicit quantification of non-diversifiable risk and the concomitant capital charges, insurers have increasingly moved away from business models in which non-diversifiable risk is kept on their books and towards models that pivot on the provisioning of asset management services. In the case of Standard Life, this shift has been wholesale: the company is now profiling itself explicitly as an asset manager. In other cases, however, the shift is more subtle. Prudential, for instance, remains among the largest life insurers in the UK but has stopped writing annuities. With the changes in insurers’ epistemic machinery, in other words, came changes in the structure of the products sold by life

insurance companies too. The question which drove which, however, cannot be answered decisively: rather, they seem to have been mutually reinforcing processes, characterised by the opening up of strategic opportunities that drove life insurance towards financial services.

*The hegemonic status of financial economics*

Why were the exemplary problem solutions of modern finance theory so influential in shaping insurers' evaluation practices? What does their 'performative power' (Svetlova, 2012) consist of? Answering this question, I argue, requires consideration of the declining legitimacy of actuarial expertise and the capacity of no-arbitrage models to establish links across different professional ecologies – to serve as a strategic 'hinge' (Abbott, 2005). Actuaries had first hinted at some potential applications of option pricing theory in life insurance not long after the Black-Scholes-Merton model was published in 1973; by the late 1990s, a generation of actuaries had emerged who challenged the status quo in the epistemic field. However, only when insurance supervision was integrated with banking supervision and the collapse of Equitable Life had raised questions about the legitimacy of actuarial expertise, did the challengers become the dominant epistemic group. Supervisors perceived no-arbitrage modelling as more 'objective', which I argued was because it circumvents the need to forecast the future. It analyses the economic value of financial instruments and insurance products in a 'synchronous' fashion (Langenohl, 2018). No-arbitrage modelling (and, indeed, the market-consistent modelling of insurance liabilities) thereby appears to exteriorise judgment from the valuation problem, and, in so doing, formally removes discretion from the equation. In so doing, no-arbitrage modelling articulated well with the regulatory aim to restructure the distribution of authority in the insurance field and successfully allowed for the emergence of a coalition of younger actuaries with experience in a range of different professional ecologies, shareholders, investment bankers and supervisors (some of whom had experience in the supervision of banking) who supported its uptake.

This finding, I suggest, has implications for how we should understand the authority of modern finance theory. One of the key questions in the social studies of

finance is the ‘performative power’ (Svetlova, 2012) of financial models: why are some models more influential than others? Literature in the social studies of finance has addressed this question by looking at the organisational and institutional environment in which models are deployed (Svetlova, 2012; MacKenzie and Spears, 2014a; Wansleben, 2018). Seen from this perspective, the widespread usage of the Black-Scholes equation may, for example, be explained by its ‘high academic standing’, its practical utility in solving specific organisational problems, and its public availability (MacKenzie, 2007, p. 71). Model usage, however, is often rather creative (Svetlova, 2009, 2018a). Whether and how models have ‘performative power’ thus depends in this perspective on *how* model usage is ‘embedded’ in the institutional and organisational environment (Svetlova, 2012; MacKenzie and Spears, 2014a).

In insurance, the exemplary models of financial economics acquired performative power because they became a core part of the institutional environment. Their academic standing, practical utility and public availability, however, seem insufficient to explain why they became so. Although these factors may have been necessary conditions, the limited use of these models prior to the 2000s suggests that other factors played a role too. In this study, I suggest, we have seen a dynamic at work that is akin to a dynamic described in the literature on the political power of economic ideas (Abdelal *et al.*, 2010). Work of this kind tends to argue that ideas are key drivers of institutional change. In times of crisis, Blyth (2002) suggests, economic ideas may help reduce uncertainty by providing a framework for understanding the causes of the crisis and by providing a blueprint for institutional change. A similar dynamic was observed in UK life insurance in response to the annuity guarantee crisis and the demise of Equitable Life. It is difficult to overstate the importance of this crisis. When I asked interviewee BC why supervisors chose to impose market-consistent modelling (a type of modelling that had not yet been developed) rather than using the real-world stochastic approaches to valuation developed in the 1970s (see chapter 3), he replied: ‘I think ... there wasn't so much a rejection of the real-world stochastic approaches. It was more a rejection of the actuarial approaches that existed previous to that. ... The motivation is Equitable Life, Equitable Life, Equitable Life’ (interviewee BC).

No-arbitrage models thus provided a convincing interpretative framework for understanding the crisis and was seen as a ‘blueprint’ for addressing its causes. Proponents of market-consistent modelling perceived actuarial discretion as the problem, not the solution. But as the above quote suggests, this interpretative lens need not imply a rejection of the real-world stochastic simulation models. I argued that it was the capacity of no-arbitrage models (chapter 5) and risk management techniques (chapter 6) to rally together a coalition of actors across different professional ecologies – a process facilitated by the fading of boundaries between the insurance field and the adjacent field of banking (as reflected e.g. in the integration of banking and insurance supervision) – which proved to be a crucial contributing factor in their ascendancy to the dominant exemplar in the epistemic field of actuarial science (Abbott, 2005; Seabrooke and Tsingou, 2009). Without the support from supervisors with a banking background and investment bankers, who perceived market-consistent modelling as a necessary condition for the introduction of new (derivatives-based) risk management techniques, the shift towards techniques borrowed from modern finance theory would likely have been slower and/or less wholesale.

It is important not to exaggerate the ‘power’ of modern finance theory. Even if theoretical models may play an important role in formatting economic calculations, the source of constraint should always be traced back to particular causes, not to the models’ intrinsic meaning. This is a direct implication of the finitist perspective on economic knowledge on which the analysis in this dissertation relies. The extension of an exemplary problem solution to new instances inevitably requires implicit or explicit decisions that are contestable in principle. To understand the influence of a particular set of exemplary problem solutions, it is, therefore, necessary to investigate how those decisions are made and how particular applications are enforced. The authority of the key exemplars of modern financial economics does not just rely on its ‘objectivity’ but also on the construction and maintenance of that objectivity.

## Limitations and prospects

To conclude this dissertation, I make some concluding remarks on the limitations of this study and point at some potential avenues for future research. The first limitation is that this study has focused on quite a narrow geography. The choice to do so was motivated by the fact that regulatory changes at the European level were preceded and in part driven by developments in the UK. In order to understand EU-wide developments, it is thus necessary to look in more detail at UK-specific developments. The UK life insurance market is of interest of itself, especially considering its long history and its sheer size. It would also be worthwhile, however, to compare its evolution to that of industries in jurisdictions where the shift towards market-consistent valuation and risk-based capital has been less pronounced. This is the case, for instance, in the two largest life insurance markets globally, the US and Japan (the UK market being the third largest). A comparison of the historical trajectories of evaluation practices across these jurisdictions would allow for an examination of factors contributing to the relative stability of evaluation practices. How is it that in some countries the emergence of unit-linked insurance triggered a series of events that led to a radical overhaul of insurers' epistemic machinery, while in others it did not? Do actuaries have a stronger jurisdictional claim in those countries, or should these differences be explained differently?

The scope of this study was not only constrained geographically but also in terms of its focus on the life insurance market rather than focusing more broadly on the market for long-term savings products. This, again, was the result of a conscious choice: the transition towards market-consistent valuation and risk-based capital calculation in insurance preceded similar developments in the world of pensions. This study, however, could not entirely ignore the world of pensions, because it is intricately entangled with the world of insurance, not only because insurance companies are amongst the most important pension providers, but also because many of my interviewees have worked in both fields. With the changes in the epistemic machinery across both fields, moreover, we saw that differences between pension funds and insurance companies faded, paving the way for the transfer of pension liabilities to insurance companies. Nevertheless, the worlds of insurance and

pensions are not entirely the same and there is much space left for an investigation of the social and political dynamics around the changing evaluation practices in the world of pensions. The controversy around the actuarial valuation of the Universities Superannuation Scheme provides a case in point.

A third and final limitation is that this study has focused primarily on the relation between evaluation practices and the structure of competition among life insurers, but less so on the interface between life insurers and their customers. This was a strategic choice, partly because limitations in time and space forced me to make analytical choices and partly because literature in the sociology of insurance has already provided excellent insights in the role of marketing and underwriting practices in the making of risks (van Hoyweghen, 2007, 2014; McFall and Dodsworth, 2009; Lehtonen and Liukko, 2010; Lehtonen, 2014; McFall, 2015). This literature tends to emphasise the importance of ‘attachments’ in the constitution of markets for life insurance, more so than the calculative procedures that underpin them (e.g. McFall, 2011). Nevertheless, the findings of this dissertation suggest that the institutionalisation of market-consistent valuation and risk-based capital calculation has presented new opportunities and obstacles for the making of markets in insurance risks, such as mortality, morbidity and longevity. An open question remains whether and how the institutionalised evaluation practices permeate not just insurers’ financial management and ‘board level’ strategic decision making but also life insurers’ marketing, underwriting and claims management practices – a question that becomes all the more interesting with the recent move towards ‘personalised’ insurance schemes (Meyers and van Hoyweghen, 2018; McFall, 2019).

On a final note, I want to stress that the history of evaluation in life insurance is far from over. There are a number of developments that are likely to affect insurers’ evaluation practices in the years to come and therewith the nature of insurance arrangements in the UK and elsewhere. The prospect of Brexit, for instance, has initiated renewed attention to the politics of Solvency II. Presently both UK supervisors and insurers are unhappy with some of the core features of Solvency II, such as the risk margin (see chapter 7). The tension between traditional actuarial evaluation practices has subsided but not disappeared, raising the question of



whether Brexit will be seized by UK actors as an opportunity to diverge from the prescriptions of modern financial economics. Another crucial development, which has currently reached the stage of implementation, is a new international accounting standard for insurance liabilities, IFRS 17, which has been long in the making (its development preceded that of Solvency II – see chapters 5 and 7), and diverges in some important respects from Solvency II, even if it was similarly designed along market-consistent lines. Similarly, the International Association of Insurance Supervisors is working on the development of global insurance capital standards, based on principles of market-consistent valuation and risk-based capital calculation – a project that seems even more complicated than the development of Solvency II, for it multiplies the number of jurisdictions with diverging practices. In other words, to understand how the institutionalisation of market-consistent valuation and risk-based capital calculation will shape the structure of insurance markets in the future, it is important to investigate how the history of evaluation in life insurance continues to unfold.



## Appendix A: List of Interviewees

Name	Place	Date interview 1	Date interview 2
David Belsham	London	01 November 2017	
David Blake	London	19 February 2018	
Paolo Cadoni	London	20 June 2017	
Andrew Cairns	Edinburgh	26 April 2017	
Andrew Chamberlain	London	21 February 2018	
John Cliff	London	20 February 2018	
Gavin Conn	Edinburgh	09 November 2015*	
Maggie Craig	Edinburgh	08 May 2018	
Seamus Creedon	London	23 June 2017	
David Dullaway	London	22 February 2018	
Nick Dumbreck	London	24 June 2017	
Adrian Eastwood	Edinburgh	14 September 2017	
David Forfar	Edinburgh	15 May 2017	
Kamran Foroughi	London	22 February 2018	
Paul Fulcher	London	22 February 2018	
Stewart Gray	Edinburgh	09 November 2015	
David Hare	Edinburgh	03 April 2017	
John Hibbert	Edinburgh	07 April 2017	18 December 2017
Karel Van Hulle	Phone	05 March 2019	
Parit Jakhria	London	21 February 2018	
Malcolm Kemp	London	31 October 2017	
Robert Kipling	London	30 October 2017	
Ad Kok	Phone	04 October 2018	
Angus Macdonald	Edinburgh	26 May 2017	
Stephen Makin	Edinburgh	19 June 2017	
Steven Morrison	Edinburgh	15 May 2017	
Martin Muir	Phone	03 May 2018	
Tiziana Perrella	London	17 May 2018	
Andrew Reid	Phone	18 June 2018	
Paul Sharma	London	01 November 2017	
Sandy Sharp	Edinburgh	09 November 2015*	18 June 2018
Nick Silver	Phone	13 June 2018	
Andrew Smith	London	21 June 2017	
Cliff Speed	London	23 February 2018	
Andrew Stoker	London	15 May 2018	
Philip Tervit	Edinburgh	28 October 2015	13 June 2017
Craig Turnbull	Edinburgh	04 April 2017	24 November 2017
Elliot Varnell	London	31 October 2017	
David Wilkie	Woking	09 August 2017	
Colin Wilson	London	22 June 2017	
Rob Yuille	London	16 May 2018	

\*Combined interview.



# Notes on Sources

The non-published sources used in this dissertation were obtained from:

The library of the Institute and Faculty of Actuaries (all documents, except the yearbooks, are catalogued online; the relevant documents were retrieved upon request by the librarians)

Personal papers of John Hibbert (the documents were selected by Hibbert)

Personal papers of Andrew Smith (the documents were selected by Smith)

The following pieces of legislation were cited but are not included in the bibliography:

*Insurance Companies Amendment Act 1973*, chapter 58. Available at:

[http://www.legislation.gov.uk/ukpga/1973/58/pdfs/ukpga\\_19730058\\_en.pdf](http://www.legislation.gov.uk/ukpga/1973/58/pdfs/ukpga_19730058_en.pdf)

‘First Council Directive 79/267/EEC of 5 March 1979 on the coordination of laws, regulations and administrative provisions relating to the taking up and pursuit of the business of direct life assurance’ (1979) *Official Journal* L063, p.1

‘Council Directive 92/96/EEC of 10 November 1992 on the coordination of laws, regulations and administrative provisions relating to direct life assurance and amending Directives 79/267/EEC and 90/619/EEC (third life assurance Directive)’ (1992) *Official Journal* L360, p.1

‘Directive 2009/138/EC on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II)’ (2009) *Official Journal* L335, p.1

‘Directive 2014/51/EU amending Directives 2003/71/EC and 2009/138/EC and Regulations (EC) No 1060/2009, (EU) No 1094/2010 and (EU) No 1095/2010 in respect of the powers of the European Supervisory Authority (European Insurance and Occupational Pensions Authority) and the European Supervisory Authority (European Securities and Markets Authority)’ (2014) *Official Journal* L153, p.1



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