

To change or not to change. The evolution of forecasting models at the Bank of England

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Abstract

Why do policymakers and economists within a policymaking institution choose to throw away a model and to develop an alternative one? Why do they choose to stick to an existing model? This article contributes to the literature on the history and philosophy of modelling by answering these questions. It delves into the dynamics of persistence, change, and building practices of macroeconomic modelling, using the case of forecasting models at the Bank of England (1974-2014). Based on archives and interviews, we document the multiple factors at play in model building and model change. We identify three sets of factors: the agency of modellers, institutional factors, and the material factor. Our investigation shows the diversity of explanations behind the decision to change a model: each time, model replacement resulted from a different combination of the three types of factors.

Keywords: macroeconomics, macroeconomic modelling, models, Bank of England, forecasting, central banks

Introduction

In the fall of 2011, the Monetary Policy Committee (MPC) of the Bank of England started to rely on a new forecasting platform to inform its monetary policy choices. This platform introduced COMPASS, a ‘new Keynesian’ Dynamic Stochastic General Equilibrium (DSGE) model, a type of macroeconomic model that had become widespread in policymaking institutions over the previous decade. The implementation of COMPASS may seem surprising, especially considering that it came only a few

years after the onset of the Global Financial Crisis. Indeed, the crisis led many to criticise DSGE models for failing to include financial and banking components, thus mischaracterising the economic system and, ultimately, being blind to the signals of an impending crisis.¹ Why then was COMPASS adopted in this context? More broadly, why do agents within a policymaking organisation decide to throw away one model and develop a new one? Alternatively, why do they decide to stick with what they have? In this paper, we provide answers to these questions by studying the evolution of modelling practices at the Bank of England between 1974 and 2014.

The literature on economic models is vast, but most of it does not attempt to explain the persistence or change of modelling practices.² The focus of authors with a philosophical leaning—including influential contributors such as Morgan & Morrison (1999); Sugden (2000); Mäki (2005); Boumans (2005); Morgan (2012); Rodrik (2015)—is typically on the nature and functions of models (Morgan & Knuuttila, 2012). The same focus persists in recent philosophical contributions about macroeconomic models (e.g., Kuorikoski & Lehtinen, 2018). Within social studies of finance and economics, most research efforts are directed toward documenting the performativity of economic modelling—i.e., the sociopolitical effects of modelling practices (MacKenzie et al.,

¹ See e.g. Stiglitz (2011), Romer (2016), or Vines & Wills (2018), for post-crisis debates on the relevance of DSGE models. Despite these criticisms and despite the advocacy for new approaches (e.g. Haldane, 2012; Mehrling, 2010), the case of the Bank of England is not an exception: DSGE models (even if amended and extended) remained widely used in academia and in policymaking institutions, notably in central banks, for forecasting and policy analysis (e.g. Gürkaynak & Tille, 2017).

² Our adoption of the concept of ‘practices’ builds on a decade-long impetus in this direction by scholars in the history of economics (Maas et al., 2011; Stapleford, 2017).

2007)—with significant attention recently placed on macroeconomic models (Ban, 2015; Braun, 2014; Heimberger et al., 2020; Henriksen, 2013).

In the smaller subset of literature aiming to explain model persistence and change, various explanatory factors are emphasised. Standard approaches in the history of economics tend to prioritise the agency of academic economists. Studies on macroeconomics discuss at length the influence of John Maynard Keynes, Robert Lucas, James Tobin, and other major economists (De Vroey, 2016; Ingrao & Sardoni, 2019; e.g., Snowdon & Vane, 2005). Although these economists are important references, centering the history of macroeconomic modelling on them generates various blind spots. For instance, recent scholarship has highlighted ‘how much of the history of macroeconometric modelling took place outside universities’ (Boumans & Duarte, 2019, p. 398). This suggests that we should pay more attention to the *agency of modellers* outside academia, by drawing for instance on the sociology of the economics profession (e.g. Coman, 2019; Fourcade, 2009). Such agency is however not what most of the existing literature on model changes has focused on. Sociologists and political scientists single out *institutional factors* that shape the evolution of models, that is, the opportunities and constraints faced by modellers. Helgadóttir (2021b, 2021a) argues that the ‘publish or perish’ characteristic of the academic environment is an important explanatory factor of the rise of ‘portable models’ such as Real Business Cycle models in the 1980s. Helgadóttir & Ban (2021) also explain model persistence in academia with institutional factors: the control of gatekeeping positions (e.g., editorial board membership of ‘top’ journals) by mainstream economists would fuel the persistence of the rational expectations assumption in academic macroeconomic modelling despite vigorous criticism in the aftermath of the Global Financial Crisis.

Institutional factors also play a role within policymaking organisations, which carry their own set of constraints and opportunities for modelling practices. That models act as ‘bridges’ between researchers and policymakers in these organisations ([den Butter & Morgan, 2003](#)) implies that the beliefs, methodological preferences and priorities of senior policymakers affect in-house modelling practices. These practices also respond to institutional logics beyond the organisation. For instance, Mudge & Vauchez ([2018, p. 268](#)) explain the persistence of the main macroeconomic model of the European Central Bank (ECB), despite its predictive limitations, by the embeddedness of this organisation in ‘three transnational systems of relations: professional economics, transnationalized finance, and EU institutions.’ According to these authors, this position of the ECB makes its model ‘too embedded to fail.’

Finally, historians of modelling practices need to be attentive to another type of opportunities and constraints that come from the fact that models are artefacts ([Halsmayer, 2017, 2018](#))—a point already underlined in the historical and philosophical work of Morgan ([2012](#)) among others. These tools are powerful, but also unwieldy. Implementing new macroeconomic models requires large amounts of funds, infrastructure, and technical know-how, and maintaining them is almost equally challenging (see eg. Acosta et al., 2023). The *material* factor is important to account for the persistence or change of modelling practices.

This article provides a complementary perspective on the history of macroeconomic modelling in policymaking organisations. In carefully studying four episodes in the evolution of modelling practices at the Bank of England over four decades, we highlight the hitherto understudied *agency of modellers*—how their background, beliefs and methodological preferences are conducive to persistence and change. Second, we distinguish two kinds of *institutional* factors: direct and indirect. Direct institutional

factors refer to power struggles between the Bank and other UK public authorities, changes of mandate and function as well as to preferences of the Bank of England policymakers regarding model characteristics. Indirect institutional factors refer to the intellectual context about modelling, which is shaped by academia and modelling practices within other central banks. Third, we explain how *material* factors constrain modelling routines and practices, and thus might contribute to model change. The main lesson of our research is one of diversity: an explanation of persistence or change must be sought for each episode in the rather unique configuration of agency, institutional forces and material reality. Our article can thus be read as a plea to be attentive to these three general explanatory factors and their combination.³

To explain *why* practices change, we must first identify *how* they change, and this requires carefully documenting the distinctive set of practices that underlies each model. The bird's eye view adopted by most of the literature on model persistence or change—e.g., lumping big families of models together under labels such as ‘DSGE’—obfuscates those characteristics of each model that relate to different intellectual, institutional or material constraints. To describe models properly, we draw on the aforementioned historical and philosophical work on the functions of models, e.g., Boumans's (1999) idea that models are ‘recipes’. Modellers choose a theoretical framework and some key mechanisms. Modellers must also make choices regarding the *size of the model* (such as the number of variables and behavioural equations included in the model), its exclusive character (should policymakers rely on a single model or on a suite of models?) and the

³ For recent historical research adopting a similar perspective to study the emergence of macroeconomic modelling in the 1960s and early 1970s in the US Federal Reserve, see Cherrier & Backhouse (2019) and Acosta & Cherrier (2021).

empirical strategy for running the model. The choice to build a new model which is smaller than the current one, for instance, may be related among other things to computational limitations, policymakers' preferences, or modellers' training. It is therefore necessary to disaggregate the different modelling choices: these choices make visible the interplay between the agency of modellers and the institutional and material factors they face.

We thus provide the first detailed history of macroeconomic modelling at the Bank of England (hereafter, BoE or the Bank),⁴ one based on a large set of documents collected at the BoE Archive or on the BoE website, as well as on 30 semi-structured interviews conducted between October 2019 and May 2021 with former and current BoE executives and staff.⁵ Each of the next four sections focuses on one episode with its specific configuration of factors. In 1979, Margaret Thatcher won the UK general elections and formed a government influenced by monetarist ideas. During this period, these ideas shattered both the UK academic and political consensus. And yet, this period of intellectual turmoil left the BoE model unchanged (Section 2). In 1992, the UK left

⁴ Current historical scholarship on the BoE has focused on the institutional context and the history of policy decisions (Elgie & Thompson, 1998; James, 2020; Kynaston, 2017; Needham, 2014). The history of macroeconomic modelling in the UK has focused on other institutions than the Bank (Ball & Holly, 1991; Barrell et al., 2018; Hall & Henry, 2018). Hendry & Muellbauer (2018) documents the genealogy of BoE macroeconomic models viewed through the lenses of methodological and technical debates.

⁵ This article is also informed by previous research on the Bank (Acosta et al., 2024) and, even if not used directly in this article, the quantitative analyses undertaken previously. For information about our interviews, see the online appendix of (Acosta et al., 2024) at <https://zenodo.org/records/8436759>.

the European Monetary System; this led the UK government to rethink its monetary regime and to give more responsibilities to the BoE, which eventually became independent in 1997. In Section 3, we explain how this new mandate led BoE economists to develop a new model, yet one that did not reflect the recent transformations in macroeconomic scholarship. Conversely, it was the growing gap between BoE practices and the rise of DSGE models in academia that largely drove the next model change in 2003 (Section 4). The final model replacement in 2011 was the result of longstanding dissatisfaction with the 2003 model, more than a consequence of the Great Financial Crisis. BoE modellers settled on a textbook DSGE model. This change seems unrelated both to the challenges that DSGE models faced and to the new policy context (e.g., the implementation of quantitative easing after the financial crisis). It rather reflected a shift in the practices and epistemological status of macroeconomic models used for forecasting. Indeed, the new model was embedded in a suite of diverse models (Section 5).

1 Resisting Thatcher and monetarism

The Bank started using an in-house macroeconometric model in 1972, after acquiring a copy of the one developed by the London Business School (LBS).⁶ The model was handled by the economic staff of the Economics Division.⁷ The staff saw the model

⁶ This occurred in an era where the use of macroeconometric modelling was still not seen as the “norm” in policymaking in the UK (Ball & Holly, 1991, pp. 199–201). In fact, its advocates in the early 1970s felt they were facing a ‘crusade against quantification in economics’ (Peacock, 1975, v).

⁷ The BoE organisational chart has evolved numerous times across the decades. In the 1970s, the ‘Economic Section’ (then ‘Economics Division’), was tasked with conducting ‘studies

forecasts as serving two purposes: ‘First, they enable the Bank to influence [H.M. Treasury’s] forecasts; secondly, they are a source of information within the Bank.’⁸ The first purpose was tied to the UK’s monetary framework in the 1970s (one that persisted until the Bank’s independence in 1997): the government (through the Treasury) had the final say on monetary policy. The Bank simply suggested policy changes ahead of decisions, and then operationalised the Treasury’s decisions (Elgie & Thompson, 1998, pp. 58–60). The Treasury also maintained indirect control over many activities of the Bank, for instance by deciding what could or could not be published in the Bank’s *Quarterly Bulletin* (James, 2020, p. 27). This also determined the restricted circulation of the Bank’s model forecasts, which could not be disclosed publicly (Staff economist 14, interview). However, even within these limitations, acquiring a macroeconomic model gave the Bank some intellectual autonomy vis-a-vis the Treasury, as it allowed them to produce their own scenarios and forecasts. In other words, it was the power struggle between the BoE and the Treasury that spearheaded macroeconomic modelling practices at the Bank.

The first description of the Bank’s forecasting model was published in Latter (1979). The model consisted of several hundred variables and equations, disaggregating the functioning of the UK economy in dozens of distinct sectors and types of goods

which have a bearing on the choice of official policies and operational strategy and to undertake longer-term research on the working of the monetary system and other topics of concern to the Bank.’ (‘Economic Intelligence Department and Economic Section’, 01/1974, EID8/7, BoE Archives.) For a discussion of these internal changes see Acosta et al. (2024).

⁸ Ash to Dow *et al.*, ‘Draft minutes of the Model Development Group, meeting of Dec 11 1975’, 29/12/1975, 10A216/5, BoE Archives.

(distinguishing, for instance, between ‘beer’ and ‘wine & spirits’ as parts of the consumers’ spending on non-durable goods). The level of disaggregation was continuously adjusted, following the approach to macroeconometric modelling initiated by Lawrence Klein ([Goutsmedt, 2019](#); [Hoover, 2012](#); [Pinzón-Fuchs, 2017](#)). This intellectual agenda was underpinned by the idea that modelling the dynamics of national economies required describing sectors at a fairly granular level, then aggregating the resulting sets of sectorial equations. The model’s dynamics was driven by changes in income and aggregate demand. Nonetheless, Latter ([1979, p. 9](#)) warned the reader against regarding the model as a simple ‘Keynesian’ apparatus, because additional features ‘set the model at some distance from what the word “Keynesian” usually means.’

The mechanisms of the Bank model were maybe ‘at some distance’ from standard ‘Keynesianism’, but they were nevertheless at an even greater distance from alternative ‘anti-Keynesian’ frameworks—i.e. the contributions of monetarists like Milton Friedman, or new classical economists like Thomas Sargent and Robert Lucas. First, prices in the Bank’s model were determined by a set of cost-push factors (productivity, wages, world prices, exchange rates, and indirect taxes) rather than by monetary forces.⁹ The effect of ‘financial variables’ was ‘not in aggregate very great’ and was indirect, via

⁹ The Bank modellers’ formalisation of inflation was relatively consistent with UK policymakers’ understanding of inflation in the 1970s. For instance, DiCecio & Nelson ([2013, p. 394](#)) have documented the dominance, before 1979, of ‘nonmonetary approaches to inflation analysis and control’.

the effect of monetary base growth on exchange rates (Latter, 1979, p. 8).¹⁰ The model was thus far from Friedman's adage that 'inflation is always and everywhere a monetary phenomenon' (Friedman, 1970, p. 24). Furthermore, the model did not include any explicit equation describing the determinants of the demand for money, and the supply of money simply accommodated the demand (Latter, 1979, p. 8). Second, wages were determined by an exogenous markup on past prices. The level of activity, thus the level of unemployment, only influenced average earnings (6). Hence, the model did not adopt the 'expectation-augmented Phillips curve' that had spread during the 1970s (Goutsmedt & Rubin, 2018).¹¹ Finally, the paper did not mention the Lucas critique (Lucas, 1976), rational expectations, or microfoundations.¹²

These features reflected the agency of the BoE modellers, more specifically their methodological and theoretical preferences. These preferences encompass their views

¹⁰ This mechanism could be seen as consistent with the monetary approach of the balance of payment (Frenkel & Johnson, 1976), although the model did not follow the 'law of one price' (Latter, 1979, p. 9).

¹¹ Prices are mainly determined by costs, but the equation is not homogeneous in costs (Latter, 1979, p. 45). In other words, even if past prices were taken into account, this formalisation is not compatible with the natural rate (or equilibrium rate) of unemployment (Friedman, 1968) and the verticality of the long-run Phillips curve. It thus seems that the Bank's model displayed the same resistance against Friedman's and new classical economists' contributions on inflation determination as the Fed's MPS forecasting model (Rancan, 2020).

¹² For a presentation of new classical contributions in the 1970s, see De Vroey (2016); see Goutsmedt et al. (2019) for a more in-depth analysis of the context of the criticisms addressed to macroeconomic models.

about the key mechanisms influencing economic dynamics and the suitable toolkit for representing and analysing these mechanisms in macroeconomics. In this respect, their approach to modelling was consistent with that of many other modelling teams in the UK, such as the Treasury's and the National Institute of Economic and Social Research's models ([Barrell et al., 2018](#)), and abroad, for example, the Fed's MPS model ([Rancan, 2020](#)). However, the persistence of stagflation stimulated criticisms against 'Keynesianism' (and of the tools that appeared associated with it) in political debates. In the UK, monetarism, disseminated by newspapers and editorialists, gained wider popularity and captivated many Conservatives ([Needham, 2014, Chapter 4](#); [D. Smith, 1987, Chapter 4](#)). The arrival of Margaret Thatcher at 10 Downing Street further consolidated the popularity of Friedman's ideas. The relationship between the government and the Treasury on the one side, and the Bank on the other, was deeply altered. For the first time since inflation had soared in the late 1960s, the Bank was confronted with politicians who endorsed a strong stance against inflation and who pushed for a new doctrine regarding monetary policy ([James, 2020, p. 71](#)).

In March 1980 the government launched the Medium Term Financial Strategy (MTFS). The strategy specified money supply targets for monetary policy. In doing so, they explicitly relied on key monetarist assumptions ([Best, 2020, pp. 603–604](#)) and on the idea that such 'control of the money supply will over a period of years reduce the rate of inflation' ([James, 2020, p. 70](#)).¹³

Contrary to the government, BoE officials were reluctant to endorse a strict targeting of £M3. Many of them, for instance economist Charles Goodhart, who was the Bank's

¹³ The target was £M3, an aggregate that had grown by 16% a year in 1977-1979. The government wanted to shrink its expansion from 7% to 11% a year.

‘special advisor’ on monetary policy, had concluded from attempts to quantify the demand of money that the relation between the demand for money, income, and interest rates is unstable (James, 2020, p. 76). During a meeting with the Chancellor, the Bank’s Governor Gordon Richardson apparently criticised the MTFS for being ‘undesirably dogmatic, mechanical and rigid’ (Needham, 2014, p. 149). The Bank’s Deputy Governor Kit MacMahon invoked ‘Goodhart’s law’ to defend the necessity to target a larger set of variables, and not just £M3 (*ibid.*).¹⁴

Even before Thatcher’s election and the launch of MTFS, monetarism and the targeting of money aggregates had been regularly discussed at the Bank. For instance, the first meeting of the BoE’s ‘Panel of Economic Consultants’ (1977) reached the conclusion that ‘the adoption of monetary targets by the Bank does not imply wholesale conversion to monetarism [...] it is possible to believe in the importance of money & not be a convinced monetarist’.¹⁵ Regarding the Bank’s model, the economic situation and the resulting policy debates pushed the modellers, for instance, to pay more attention to the

¹⁴ The ‘Goodhart’s law’ is the idea that ‘any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes’ (Goodhart, 1984, p. 96).

¹⁵ ‘Panel of Academic Consultants, First meeting 5th October 1977: Monetary targets’, 31/10/1977, EID19/4, BoE Archives. Later on, Christopher Dow, the chief economist of the Bank at the time, or John Fforde, an executive director, imagined different arguments to make the Bank appear relatively monetarist and thus counter the attacks of monetarists (James, 2020, pp. 80–81).

monetary sector.¹⁶ However, Thatcher's government's intransigence later forced the Bank into a defensive stance.

This power struggle explains why the Bank's executives did not press modellers at the Economics Division to transform their model fundamentally.¹⁷ First, the Head of the Division, Christopher Dow, remained a faithful Keynesian. Second, the Bank's staff decided to further its analysis of the links between monetary aggregates and inflation in a separate 'small monetary model', rather than by revising the main model. A first version was presented by Richard Coghlan (1979), who promoted his model as 'an alternative [...] which places much greater emphasis on the supply of money' than the 'essentially "Keynesian"' model of the Bank (*ibid.*, 5). He acknowledged that 'certain monetary influences' had been introduced recently in the Bank's large-scale models, but highlighted the merits of studying monetary issues separately. He explained that this additional model was not a 'monetarist' one, 'since the money stock [was] not regarded as an exogenous variable directly under the control of the authorities' but as endogenously determined by demand (*ibid.*, 8). Likewise, Goodhart cautioned against interpreting the small monetary model as 'a specifically monetarist framework.' Rather, 'its main advantage is that it explores [...] the disequilibrium approach to monetary

¹⁶ The lack of an adequate monetary sector was not exclusive to the Bank's model ([Dicks-Mireaux, 1975, pp. 125–126](#)), and all UK modelling teams worked on this issue throughout the 1970s.

¹⁷ The subsequent failures of monetary targeting due to financial market deregulation and the release of exchange controls led to the adoption of a more 'pragmatic' stance towards monetarism by the government ([Best, 2020](#); [Clift, 2019](#)). This released the intellectual pressure off the Bank, and thus off modellers as well.

determination’ and, as claimed by Coghlan, ‘this could be considered as consistent with Keynesian analysis as with monetarist analysis.’¹⁸ Other similar projects were under consideration in the early 1980s. Goodhart suggested that the Bank should fund the development and the estimation of a monetary model by James Davidson and David Hendry at the London School of Economics (LSE).¹⁹ For Peter Brierley, from the Bank’s staff, this model would ‘facilitate an evaluation of policy issues within a specifically monetarist framework’ and the results could be ‘compared with those produced by the Bank and Treasury large structural models, which basically reflected a more Keynesian approach.’²⁰ Overall, Goodhart and the staff took seriously the challenges posed by monetarism, but they did not view the alternative models they were developing at the bank as a repudiation of the ‘Keynesian’ approach.

In sum, the lack of model change in the early 1980s is mainly explained by the agency of Bank modellers in the context of a power struggle between the Bank and the Treasury. Policymakers provided a buffer against Thatcher’s Monetarism, whereas the

¹⁸ Goodhart, ‘Small Monetary Model - Collaboration with Davidson’, 5/10/1981, 6A160/3, BoE Archives.

¹⁹ Goodhart, ‘Davidson and the small monetary model’, 5/11/1981, 6A160/3, BoE Archives.

²⁰ Brierley, ‘Small Monetary Model - Collaboration with Davidson’, 2/10/1981, 6A160/3, BoE Archives. In the research project they transmitted to the Bank in October 1981, Davidson and Hendry made clear that their approach ‘provide[d] a new framework for the testing of established theories such as the monetary approach to the balance of payments ... and the “monetarist” view of inflation’ (Davidson and Hendry, ‘A Proposal for Further Research on Econometric Modelling of the UK Monetary Sector’, 26/10/1981, 6A160/3, BoE Archives). Hendry regularly opposed monetarists in the 1980s, notably Friedman & Schwartz (1963) results (see [Hendry & Ericsson, 1991](#)).

modellers' own beliefs regarding the working of the UK economy determined the model's specification. Beyond the power struggle between the Bank and the Treasury, a second direct institutional factor was also at play: the role and place of the model in the Bank's organisational structure during this period. At the time, modellers and economists, in general, did not have the role and importance they would get in the 1990s, which paradoxically enlarged their discretionary power and agency ([Acosta et al., 2024](#); [James, 2020, pp. 28–29](#)).²¹ Crucially, although monetary policy implementation was the main area over which the Bank retained some independent agency, it was not discussed within the Economics Division.

Also, this lack of importance also placed strong material constraints on modellers—they lacked resources and personnel, which resulted in a growing backlog of pending modifications to the model. Indeed, the memos within the Economics Division were filled with constant reminders that computer and personnel constraints needed to be taken into account when defining how to improve the model itself and its associated operations.²²

²¹ Modellers at the Treasury, on the contrary, did not have this autonomy and were under constant political pressure—notably by Nigel Lawson, who was Financial Secretary (1979–1983) and then Chancellor (1983–1989; [R. Smith, 2003](#) and Non-BoE economist 2, interview).

²² In May 1973, the head of the Economics Division, Leslie Dicks-Mireaux, set up a research committee to identify suitable areas of research and assign priorities ‘in light of the available manpower.’ (Midgley to Dick-Mireaux, ‘Future forecast effort’, 19/03/2019, 1A6/1, BoE archives) The modelling team then repeatedly pointed to their desire to integrate equations on supply constraints or on ‘the linkages through which financial variables affect the real

2 **Small is beautiful: The development of MTMM in the early 1990s**

In September 1992, growing deficits and speculation against the Pound forced the British government to exit the Exchange Rate Mechanism of the European Monetary system. The move was largely considered as the result of a failure in monetary policy. The next month, Chancellor Norman Lamont announced that the government would set an inflation target and that the Bank ‘would be responsible for monitoring the Government’s progress’ towards the target through the publication of a quarterly *Inflation Report* (Lamont in [Elgie & Thompson, 1998, p. 77](#)). Monthly BoE-Treasury meetings would serve as a forum to discuss the evolution of the UK economy; they

economy,’ but they added: ‘it was felt that a proper exercise in this area would require a first-class economic researcher full-time for at least a year.’ (Towsend and Allen, ‘A program for research in relation to the model,’ 1973, May 31; EID 8/7, Box 10A216/3) A few months later, they again regretted that ‘manpower shortages make it impossible to achieve anything’ regarding current price forecasts (Towsend memo. ‘Memo to Dicks-Mireaux, Prospect of QMC model’, 1973, July 23. EID 8/7, Box 10A216/3). They also noted that ‘the nature of the estimation [of the main model] is so complicated and requires such a large amount of computer core storage that only a relatively simple model structure can be allowed for.’ Refining supply constraints equations was also difficult because of ‘sophisticated re-estimation problems’ which had to be delayed ‘until a data bank and better computer facilities were made available.’ In the same 1973 memo, they thus requested another programmer. In the next months and years, the small *Economic Analysis and Research Group* laboured to provide a set of computer programs to help with re-estimation procedures, seasonal adjustment of time series, yields calculations, updating requests to the LBS databank, or running algorithms to approximate a solution to the model (Ash-Dicks-Mireaux, ‘Manual for the short-term model,’ March 30, 1977, box 10A216/8).

would be planned in advance and minutes of the meeting would be issued publicly. This reform paved the way to the BoE's operational independence. Its enactment in 1997 led to the establishment of the Monetary Policy Committee (MPC). The BoE modelling team was tasked with providing inflation forecasts and policy scenarios. This new monetary framework thus made the Bank's central forecasting model a cornerstone of the monetary policy process. As soon as 1994, the BoE's staff was tasked with developing a new forecasting model, that would eventually be called the Medium-Term Macro Model (MTMM).

The main novelty of this model was its reduced size: the first version was built around a core of 'only' 12 behavioural equations (Staff economist 15, interview) and the second version had 'twenty behavioural variables' (Britton et al., 1996, p. 3). This broke with Klein's modelling tradition and represented a sharp departure from the 134 variables described by behavioural equations in the previous BoE model (in its version published by Harnett et al., 1987, p. 399). The Bank's new model also ranked, at that time, as the smallest model in use at UK policy institutions, especially compared to the Treasury's or the NIESR's models (Whitley, 1997, p. 166). John Whitley, who oversaw the construction of the new model, explained the downsizing by the desire to clarify 'the underlying economic analysis so that the numerical conclusions can be understood and used with confidence' (Whitley, 1997, p. 163). What now mattered was to pin down price determination mechanisms rather than how the output level was determined as in the previous model. The most important goal was to 'incorporate the key elements in the transmission of monetary policy to inflation' (*ibid.*).

MTMM was an estimated form of Aggregate Supply/Aggregate Demand (AS/AD) model (Britton et al., 1996, pp. 4–5). The Phillips curve, which was not formalised as such, was negatively sloped in the short run, but vertical in the long run (3). Modellers

thus assumed an equilibrium rate that they called the ‘Non-accelerating inflation rate of unemployment’ (NAIRU; [Backhouse et al., 2023](#)).²³ Inflation inertia was modelled through using nominal and real rigidities, such as a bargaining framework determining earnings (12-13). The adoption of a long-run vertical Phillips curve associated with rigidities and a bargaining framework gave MTMM a ‘new Keynesian’ flavour. Although rational expectations were still absent, two modellers, Paul Fisher and John Whitley, explained that they relied on ‘new Keynesian theory’ (78) to formalise the determination of inflation by expectations (measured through surveys) and the ‘output gap’.

Slimming the model down was not merely driven by theoretical considerations. It also reflected an organisational strategy. The new model could be entirely managed by a small team, without relying on a division of labour across different teams within the Economics Department (then the Monetary Analysis Directorate). One member of the MTMM modelling team recalls: ‘for the first time we took total control of the equations in the forecasting group. We didn’t bother having the wage experts do the wage equation, for example. We just did it all ourselves.’ (Staff economist 15, interview)

The period 1993-1994 thus initiated a major shift in the building and management of the central forecasting model at the Bank. Which factors could account for this change? A recurring answer in our interviews with economists working at the Bank in the 1990s

²³ In the last version of the previous, large-scale model, in use until 1994 ([Harnett et al., 1987](#)), there was no such discussion of the Phillips curve or of an equilibrium rate of unemployment. What determined domestic prices was the large disaggregation of the model, with a manufactured sector, a public sector and a third sector with remaining activities. The former model also had separate equations for the price of different commodities.

has been: “The short answer to this question [“why changing the model?”] is: Mervyn King” (Staff economist 7, interview). When King arrived at the Bank in 1990, becoming chief economist the next year, he had a well-established academic career.²⁴ As a taxation economist, he had published in (and edited) several of the most prestigious academic journals in economics. Though not a macroeconomist, he nevertheless held specific views on what kind of macroeconomic models should be developed.

King’s vision was that a central forecasting model had to provide policymakers with a ‘story’ about the economic mechanisms at play.²⁵ To achieve this, a model had to be simple and based on a clear and consistent theoretical framework—his definition of such a framework reflected his personal preferences for macroeconomics, some inspired by the U.S. dominant academic standards of the time.²⁶ As a result, King fiercely opposed the large-scale macroeconometric models then used at the Bank. He found them not ‘transparent’ and lacking consistent theoretical foundations, because they assembled different theoretical insights (some of which were ‘outdated’, ‘Keynesian’

²⁴ After graduating from Cambridge (BA Economics, 1969), King held several positions as Fellow and Lecturer in Cambridge, before becoming Professor at the LSE (1984). When he joined the Bank, he had just returned from a visit to Harvard and the NBER. King would become Deputy Governor in 1998, and finally Governor from 2003 to 2013.

²⁵ King’s vision at the time was reconstructed based on concurring depiction from interviews and archives; see Acosta et al. (2024, sec. 4) for more details. His vision exemplifies the role of models as providing ‘narratives’ (Morgan & Stapleford, 2023).

²⁶ During a stay at Harvard, King had developed a certain interest in new classical economics (the works by Lucas, Sargent, Kydland, Prescott) and rational expectations (Executive 3 and Staff economists 7 and 12, interviews).

ones) and were driven by econometric or empirical considerations. This vision of the chief economist was very influential in guiding the building of the new macroeconometric model from 1994 onwards.

King's uncompromising modelling vision, sustained by an unyielding management style, resulted in the resignation of those modellers who disagreed with him.²⁷ One of the economists in charge of modelling before King recalls that:

There was no justification for this shift at the time, it just happened. The boss (King) says 'this is the way to do things', and for newcomers, this was the way to progress. [...] I left the Bank because of this change of model. [...] I was delighted to do that, considering the new restrictions at the BoE. (Staff economist 7, interview)²⁸

For instance, Brian Henry, who had been instrumental in reorganising the work on the old model after 1984, left the Bank for the International Monetary Fund (IMF). King then asked Paul Fisher and Shamik Dhar to build a new smaller model for forecasting.²⁹

²⁷ A BoE executive describes King's attitude at the time:

Mervyn turns up, with one qualification: he thinks, what is inherited is useless. Useless. He thinks it is so useless, and he is so aggressive about changing things [...] I suspect Mervyn was horribly patronising to them [the staff], because they were not doing rational expectations, they were not doing modern finance theory, they probably didn't know the search models for the labour markets. (Executive 3, interview)

²⁸ Another modeller explains that:

Mervyn did not believe in empirical work very much at all. Although he came from the LSE in the UK, he really came from the American DSGE type of tradition of modelling, which doesn't really require very much data, and so he started to move the whole thing towards that sort of direction, which is when a number of us decided that we didn't need to be at the Bank anymore. (Staff economist 6, interview)

²⁹ After an MSc. at Warwick in 1983, Fisher worked for Kenneth Wallis and the

Macroeconomic Modelling Bureau (see below) and was granted a PhD in 1990 before

Whitley arrived at the Bank in 1995 and took over the management of the model from Dhar. These new appointments facilitated the change in modelling choices.³⁰

However, King's views alone were not sufficient to convince his staff to develop and operate a new, smaller forecasting model. Several of those staffers, trained in the 1970s and 1980s, actually shared some of King's views—but they were not all inclined to push macroeconomic modelling at the Bank towards the new classical approach.

Whitley and Fisher had been members of the Warwick Macroeconomic Modelling Bureau before joining the Bank. In 1983, the Social Sciences Research Council—the future Economic and Social Research Council (ESRC)—had established the Bureau ‘with the remit to improve accessibility to macroeconomic models, to promote general understanding of the properties of the United Kingdom models, and to allow comparisons between models to be made’ (Ball & Holly, 1991, pp. 212–213). The Bureau operated out of the University of Warwick, under the direction of Kenneth Wallis.³¹ Like many others at Warwick (and notably Wallis), Fisher and Whitley did not oppose structural econometric models, nor did they adhere to new classical

joining the BoE. Dhar joined the BoE in 1992 after having worked for the Treasury (1987–1990) and for a private forecasting company, Oxford Economics (1990–1992).

³⁰ Whitley worked as a research fellow at the NIESR during the 1970s before joining the university of Warwick and working for the Modelling Bureau after its creation in 1983. He was granted a PhD in 1989.

³¹ In the following decade, the Bureau published several comparative analyses of UK models, including those of LBS, NIESR, Treasury, the model of the Cambridge Growth Project, the City University Business School model, the Liverpool model and the Bank's model (Wallis, 1984). Some of these analyses were notably co-authored by Fisher and Whitley (e.g. Wallis et al., 1986).

macroeconomics. The model they developed at the BoE reflected neither of these standards—MTMM was ‘just’ a AS/AD model, with new Keynesian rigidities but without rational expectations. The modelling choices of the Bank’s staff reflected the lack of trust in the large-scale macroeconometric model that grew in the 1990s rather than an active endorsement of the new classical macroeconomics that was becoming dominant in the academic environment.³² Indeed, between 1979 and 1999, the publications by BoE staff exhibited significantly fewer references to key contributions generally associated with the new classical approach, by Robert Lucas or Finn Kydland and Edward Prescott for instance ([Acosta et al., 2024](#), Online Appendix, 3.8.1). After the mid-1990s, the ESRC decided to stop financing the work of the Warwick Bureau (Staff economist 16, interview). The Bank’s modellers reflected this changing intellectual context when they wrote: ‘We stress that the days of relying on a large macroeconometric model as a “pictorial” representation of the economy which expected to be able to answer almost any economic question thrown at it, are gone’ ([Britton et al., 1996](#), p. 2).

Finally, the choices of BoE modellers also reflected the new need to produce the inflation forecasts and policy scenarios (for any change in the Bank’s rate) that formed the basis of the *Inflation Report*. In this respect, MTMM offered several advantages in comparison to the large-scale model of the 1970s and 1980s. First, its more focused

³² Another anecdote is typical of the interplay between policymakers’ and modellers’ agencies: on a later version of MTMM, to convince King regarding how monetary policy was modelled in MTMM, and knowing that he considered inflation as ‘a monetary phenomenon,’ they added a supply of money equation in addition to the standard policy reaction function, even if this was not required in the model (Staff economist 11, interview).

theoretical structure allowed modellers and policymakers to understand more straightforwardly which mechanisms drove the results, and to draw narratives from them (one of King's wishes). Second, on the material aspect, its small size made it easier to modify some equations at the margin and reduced the computational burden of running new forecasts.³³

Both King and the staff were aware that a model producing public forecasts would be exposed to more intensive scrutiny. A small model would be particularly vulnerable to criticisms if it was to produce a simple point estimation of inflation. A first line of defence against this was to publicly expose, and thus manage their own 'ignorance' (Best, 2021): they published their forecasts as a probability distribution, displaying a (non-symmetric) margin of error around the central projection for the next quarters to come.³⁴ These 'fan charts' were launched in February 1996 and presented as an innovative form of forecasting by King and the BoE's staff (Britton et al., 1998; King, 1997). Secondly, King and the BoE's staff insisted repeatedly and publicly that the forecasts were not derived from a single model, but from a 'suite of models'. Whitley (1997) advocated for this 'eclectic approach' for modelling in policymaking institutions, arguing that 'structural vector-autoregressions (VARs), theory-based optimising approaches and macroeconometric models are natural allies rather than competitors' (163). However, according to BoE executives and economists, this 'suite' was 'a complete scam', a 'rhetorical device' (Executive 1, interview) or 'an ambition, but

³³ Rational expectations, although theoretically appealing for some modellers and policymakers, like King, remained too heavy a computational burden (Cherrier et al., 2023).

³⁴ Moreover, King was sensitive to the idea that the economic context was subject to 'radical uncertainty' (Kay & King, 2020).

never the truth about how the inflation forecast was really done’ (Staff economist 12, interview). Even if the ‘suite’ was never used for forecasting at the time, the idea of a suite exemplifies both the loss of confidence in forecasting models and the wish to avoid the central model becoming an easy target for the Bank’s critics.

The new policy framework that emerged between 1992 and 1997 was thus an important direct institutional factor that encouraged the change of model. In making the model’s forecast more central to the bank’s operations, it highlighted the material constraints underpinning the operation of the old large-scale model. The development of a smaller model also came from another direct institutional constraint: King, the chief economist, favoured such small models. Nonetheless, the theoretical content of the model was essentially in line with the past experience of the modellers in charge of building MTMM.

3 Keeping up with academic standards and forecasting performance: The BEQM model

Because they formed the basis of monetary policy discussions within the Monetary Policy Committee (MPC), the forecasts produced with the MTMM, and their underlying mechanisms, were much debated. Again and again, the external MPC members (i.e. those who were not BoE Executives) challenged forecasts ([James, 2020, p. 436](#)).³⁵ Additional criticisms came from outside the Bank and the MPC (including academic criticisms, like [Arestis & Sawyer, 2002](#)). In 2001, the House of Lords Select Committee on Economic Affairs recommended an independent audit of the BoE forecasting

³⁵ As a former executive explains, ‘you had [external members] who were never holding back what they thought. We never knew if they would sign the Bank forecast’ (Executive 2, interview). On ‘dissent’ within the MPC, see e.g. Harris et al. ([2011](#)).

model.³⁶ The Bank itself also commissioned Adrian Pagan, an Australian econometrician and former Board member of the Reserve Bank of Australia, to assess ‘whether [BoE’s economic modelling and forecasting work] is “state of the art”’ (Terms of references, cited in [Pagan, 2003, p. 62](#)).

But even before political pressures mounted and the results of these investigations were known, the bank modelers, who were dissatisfied with MTMM (Staff Economist 3, interview), had already started to work on a new model, later named BEQM ([Harrison et al., 2005](#)). The Bank staff was already at work on BEQM by September 2000, before Pagan’s review even began. The model started being used in forecasting rounds in 2003. A former BoE executive recalls: ‘the pressure for changing the model came rather from staff than from the MPC’ (Executive 1, interview). The same interviewee adds: ‘Basically, the MPC was not uninterested [in modelling], but they would not be involved in the process (“you should do it this way, or that way”).’ A former BoE modeller agreed that the model per se was not at the centre of the concerns and demands of MPC members:

Day-to-day, during the process of producing the forecasts, most Committee members very rarely mention the word ‘model’ [...] occasionally, they ask ‘how does this work in the model.’ [...] It makes it less likely, in the way we interact with the [MPC members], to have a discussion like ‘Hang on, this model is not working for us.’ [...] Changing models is very costly and painful for us to go through. If we want to change, the change has to come from the bottom-up, from the staff’s desire to do it. I think this was the case in this case [BEQM]. (Staff economist 2, interview)

³⁶ House of Lords, 2001, ‘Response of the Government to the Report of the House of Lords Select Committee on the Monetary Policy Committee of the Bank of England’, House of Lords Paper 34, Session 2000-01, February 2001.

In particular, the staff saw MTMM's theoretical structure as not fully stock-flow consistent, something that the Bank executives also complained about (Staff economist 2, interview).³⁷ The staff was also adamant to address recurring questions from the MPC on which MTMM was silent. A BoE modeller recalls: 'For example, there was a debate [in 1996] about anticipated productivity growth, potentially driving the huge appreciation in the exchange rate, and that could also impact expectations on future wealth: what was the theory behind that? That was something that was not straightforward to deal with in MTMM.' (Staff economist 3, interview) The staff understood that solving such problems rather required building a new model 'from the ground up', taking for instance stock-flow consistency as a starting principle and making the necessary consistency arrangements for introducing new types of expectations.

Moreover, the staff ambitioned to introduce substantial theoretical changes, moving the BoE forecasting model closer to the standards of academia and of other central banks—in short, closer to a DSGE model.³⁸ A former BoE executive recalls:

³⁷ For instance, generated profits were not feeding back into any agent resources.

³⁸ Obviously, the benchmark DSGE model did not stabilise until Christiano et al. (2005) and Smets & Wouters (2003). Even the label 'DSGE' was not widely used before the mid-2000s. However, one can already identify, in some mid-1990s contributions (Clarida et al., 1998; Cooley, 1995) some distinctive characteristics of what became the benchmark DSGE model of the mid-2000s. That is: a representation of the economy as the equilibrium outcome of optimising individual behaviour (in short: 'microfoundations'); exogenous shocks generating the dynamics; sluggish adjustment to shocks, due to real and/or nominal frictions.

MTMM did not really have microfoundations. Academia was moving on: you had the DSGE approach developing as the standard framework for a lot of academic work. [...] So the staff started pushing in that direction. (Executive 1, interview)

A BoE economist involved with the BEQM project confirmed the overall motivation, although emphasising that policymakers were also open to the development of a new model closer to these academic standards and ‘what other central banks were doing,’ a BoE economist recalls, explaining that ‘the key motivation was to have at least the core of the model to be better microfounded.’ (Staff economist 2, interview)

The impulsion for BEQM, though coming ‘from the bottom’ and modellers’ agency, was not disconnected from the institutional changes that had come ‘from the top’ during the previous decade. By the turn of the 2000s, King’s modelling vision and preference for small microfounded models had become entrenched in the modelling team through years of hiring and promotion (Acosta et al., 2024). King’s new recruits had brought the BoE modelling culture closer to the new generation of models (DSGE), which was developing in US academia and in a few other central banks (like the Bank of Canada). In 1994, he hired Andrew Scott (who had just completed his PhD in Oxford) as an external consultant to the Bank. Scott was to conduct, in collaboration with BoE staff, the ‘Small Analytical Model Project’ (Holland & Scott, 1998, p. 1). The outcome of the project was a UK-calibrated model mostly consisting of the neoclassical growth model *a la* Kydland & Prescott (1982) and Long & Plosser (1983), with a stochastic trend and fluctuations mainly driven by productivity shocks. Such a model was allegedly part of the suite (Whitley, 1997, p. 166), but it was not intended to produce forecasts (hence, it was not intended to replace MTMM); rather, its role was to ‘identify the causes of the business cycle and outline the propagation mechanisms’ (Holland & Scott, 1998, p. 7). The actual use of this model turned out to be quite limited, as a former BoE economist

recalls: ‘A lot of money was spent on [the small analytical model project], but it didn’t really go anywhere, except it was the first infusion of the US modern macro into the Bank.’ (Staff economist 12, interview)

Other recruits were much younger, so that by the late 1990s, a generational shift was under way. The new modellers had been trained in a more international environment (see [Acosta et al., 2024, sec. 4](#)). As a consequence, they had grown sceptical of the old macroeconomic modelling approach and, in line with King’s vision, exhibited an interest in furthering DSGE-style modelling at the Bank. A former staff member, who entered the Bank in 1992, recalls:

I was probably closer to Mervyn King intellectually. [...] I was slightly disillusioned with the UK macroeconomic modelling tradition at the time [...] I felt that Mervyn’s approach was much cleaner, much more in tune with modern macroeconomics. I think that a lot of UK economists who were working at that time had a strong resistance to that approach. They felt it was too stark, too simplistic, and frankly they also hold on to the techniques and systems they grew up with. [...] I was increasingly impressed by DSGE-type modelling [...] That I felt was what you had to provide to Mervyn. (Staff economist 5, interview)

As a result, a few macroeconomists within the Bank staff had gradually begun to engage with a new generation of models during the 1990s. Interaction with academia was encouraged although this initially led only to a few visible outputs, such as individual working papers and publications in peer-reviewed journals ([Batini et al., 2003](#); [Dhar et al., 2000](#); e.g. [Millard et al., 1997](#); [Nelson & Nikolov, 2004](#)). The BEQM project represented a change in scale in that it involved the whole modelling unit, consisting of around 20 economists. The six modellers who more specifically authored the model and its documentation ([Harrison et al., 2005](#)) had all joined the Bank in the mid-1990s, straight after graduating with masters in economics in the UK (Ryland Thomas in 1994;

Meghan Quinn in 1996; Richard Harrison in 1998; Kalin Nikolov and Gareth Ramsay in 1999) or abroad (Alasdair Scott in 2001). They had all begun their careers at the Bank in Monetary Analysis (MA), often starting in the Monetary Strategy and Assessment Division, ‘[the Bank’s] biggest interface with the academic works ... attracting new staff that was more research-oriented’ (Executive 1, interview), before joining the Conjunctural Assessment and Projections Division, in charge of the forecasting model.

The BEQM modelling team was led by Harrison and Alasdair Scott (Staff economists 1 and 12, interview). After an MSc at the LSE, Harrison joined the Bank in 1998 and started working on monetary policy rules in open-economy models (e.g. [Batini et al., 2003](#)). When Harrison boarded the BEQM project in September 2001, he was a relatively new (and young) member of the modelling unit, having spent only 3 years at the Bank. Although also young, Scott had arrived at the BoE already carrying significant experience in macroeconomic modelling. He had worked previously (from 1998) at the Reserve Bank of New Zealand, where he participated in the development of a ‘core model’ for forecasting purposes ([Hunt et al., 2000](#)). The ‘core model’ consisted of a small calibrated general equilibrium model, based on optimising, forward-looking behaviour of economic agents, and frictions ensuring a sticky adjustment back to steady-state after any exogenous shocks. It thus embodied the essential features of the DSGE approach.³⁹

³⁹ Some formulations were different from what later became the benchmark DSGE model.

These differences included for instance: a Blanchard-Yaari specification for household behaviour, instead of a “Ricardian/non-Ricardian” household assumption; Rotemberg

In developing BEQM, BoE modellers faced several issues[BC1] , which led to compromises with the new DSGE approach. First, BEQM was developed too early, ahead of the emergence of a stabilised, benchmark DSGE model in academia and central banks. As mentioned above, DSGE-like models had been designed throughout the 1990s, but it was not until the 2000s that larger versions were developed within policymaking institutions for policy purposes. In 2002-2003, the IMF and the Fed’s Board of Governors built two similar multi-country DSGE-type models to be used in policy routines, scenario analysis, and forecasting—respectively, the Global Economy Model (GEM, [Bayoumi, 2004](#)) and the SIGMA ([Erceg et al., 2005](#)). Meanwhile, the European Central Bank developed its new model, based on Smets and Wouters’s ([2003](#)) work. These three projects rapidly set the theoretical and empirical benchmark for DSGE models, either in academia or in central banks. Because the BEQM project was 1-2 years ahead of these other institutions’ projects, several modelling choices diverged from those adopted by GEM, SIGMA, and Smets-Wouters. Although these differences did not seem significant at that time, they have been retrospectively seen as a “missed opportunity”. One of the BoE staff involved with the BEQM project argues:

I think there is a lot in terms of the timing. [...] Between the specific time we have chosen to start and the time it took to get to the end, this meant that we missed some of the opportunities that were coming up. [...] we were talking to people like Frank Smets about their effort; and our project was going on alongside what they were doing, while we had already kind of pre-set our path really. I think, if we had done the project three or four years later, things would have looked quite different (Staff economist 3, interview).

“shadow” menu costs instead of Calvo-pricing for firms; a Calvo-bargaining mechanism on the labour market instead of assuming monopolistic competition.

Furthermore, the modellers' agency had to cope with the conservative preferences of BoE executives: they wanted the new model (BEQM) to resemble the old one (MTMM) in many significant ways: 'we were trying to make the forecast process from the perspective of MPC members unchanged. [...] they should not notice the difference, from the structure of the meeting and the things that they discuss,' a BEQM modeller remembers (Staff economist 3, interview). As a consequence, the modellers decided to keep the key economic mechanisms driving inflation identical to those in MTMM, so that the baseline narrative about inflation relied on the output gap.

The modellers also understood that several topics that the MPC constantly discussed had to be included in the new model, which expanded the number of sectors and agents: BEQM 'ended up being really complex [...] Understandably, because there were a lot of important questions to ask. [...] [For instance, MPC members] wanted a supply-side with an input sector with not just domestic inputs but also imported inputs' (Staff economist 5, interview).

Finally, the BEQM modellers worried that, by bringing the new model closer to academic standards, they would lessen its forecasting performance. The then chief economist shared this concern: 'I was cautious about [changing the model], because I was sceptical about how useful a DSGE model would be upstairs [in MPC meetings]. They are good for academic exercises, but not so obviously for forecasting' (Charles Bean, interview). Therefore, he encouraged the staff to proceed with developing the new model 'providing it doesn't materially damage the fit of the model to the data. So we converge to this idea of having the theory determining the long run and the data determining the short-run' (*ibid.*). This statement illustrates the modelling strategy finally retained by the staff: BEQM combined a 'core' and a 'non-core' subset of equations. The 'core' constituted the 'organising framework for analysing the

economy,’ determining the long-run, steady state for the model economy ([Harrison et al., 2005, p. 23](#)), while the ‘non-core’ was a collection of single equations describing the evolution of additional variables (not included in the core) or adding ‘*ad hoc* dynamics’ for the short run (*ibid.*, 9). In short, BEQM relied on a form of Vector-Error-Correction mechanism, which had been very popular earlier in the 1990s. Its implementation with a core/non-core structure was quite specific to BEQM. Though conceived to accommodate the various institutional constraints that came with modelling for forecasting purposes within a central bank, the core-non-core empirical strategy nevertheless attracted significant internal and external criticism, leading, a few years later, to different modelling choices.

In a nutshell, while the impulse for launching BEQM came from staff’s agency, the project was nurtured by a new modelling culture at the Bank, itself shaped by King and the recruitment of a new generation of modellers, trained in a new intellectual context: the early emergence (1990s) and later gradual stabilisation (early 2000s) of the DSGE approach both within academia and other central banks and international organisations. Since this influence had not fully materialised into MTMM, the ambition of the BEQM modelling staff was to devise a new model that would be closer to the new standards of this approach.⁴⁰ When they began building a new model, however, neither the

⁴⁰ In academia and even more in public and international organisations relying on very large models, methods to numerically solve these models and estimate them were crucial. In the 1990s, economists have proposed various relaxation and perturbation algorithms, some that became embodied in software such as DYNARE that allowed a faster and more standardised resolution of DSGE models. In the early 2000s, macroeconomists such as Smets, Wouters and others implemented Bayesian estimation methods which were an alternative to

theoretical characteristics nor the computational and estimation strategies for this new class of DSGE models were stabilised. BEQM ended up being bigger, more complex and less legible empirically than other new models from this era, not just because of such timing, but also because policy-makers' various demands required a 'compromise' between the builders' methodological preferences and users' need for narratives.

4 Discontent with BEQM and the long road to COMPASS and its suite

BEQM operated between 2003 and 2011, when it was formally replaced by a new model, COMPASS, i.e. 'Central Organising Model for Projection Analysis and Scenario Simulation' ([Burgess et al., 2013](#), ii).⁴¹ From 2003 onwards, the reception of BEQM inside and outside the Bank had highlighted the need for a new model. BEQM had been presented by Harrison and his colleagues at the Central Bank Macromodelling Workshop (2003, 2004) to other central banks' economists and academics. In December 2005, shortly after the publication of the official documentation, BEQM was presented at an international conference, 'DSGE Modeling and Policymaking Institutions: Progress and Prospects.' During this conference, Christopher Sims offered a very harsh discussion of the BEQM core-non-core approach, which he deemed particularly problematic in terms of consistency and transparency (later published in [Sims, 2008](#)). These criticisms were endorsed by part of the BoE staff and executives. One former executive recalls: 'I read Sims's paper and I thought he was right: [BEQM] is bollocks, what have we done?! It's awful!' (Staff economist 12, interview). Misgivings about

calibration. But not only was this coincidental to the development of BEQM: software allowing for a reliable, fast and flexible use of Bayesian estimation were also just being developed ([Cherrier et al., 2023](#)).

⁴¹ COMPASS is still used today (2023).

how BEQM had been conceived only grew during the 2000s, after the DSGE approach had stabilised both in academia and in other policymaking institutions: BEQM increasingly appeared ‘out of tune.’

Some Bank executives were less affected by criticisms and by the widening gap with the new standards. Part of the BEQM team continued to defend their approach, especially the core-non-core strategy (e.g. [Alvarez-Lois et al., 2008](#)), and one executive remembers: “most people at the Bank thought: ‘These guys [who criticise BEQM] are academics, what do they know?!’” (Executive 1, interview). In his review of BEQM, Pagan ([2005, p. 191](#)) likewise explained that, though some of BEQM’s theoretical specifications ‘may not appeal to outside observers,’ modelling in academia and central banks obeyed different rules and standards: ‘the decisions taken by the builders of BEQM have to be rooted in what is tractable and what is familiar to policymakers, and one needs to recognise these constraints when making criticism,’ he pointed. All things considered, then, Pagan thought that BEQM was an overall ‘success’ and a ‘state-of-the-art’ model (*ibid.*). But a then staff member paints a different picture of the in-house reception: ‘BEQM ended up pleasing none of the sides,’ he recalls, ‘It did not satisfy the DSGE-purists, because it ended up being much *ad hoc* and larger than people felt would be useful; and it did not please the macroeconometric traditionalists, because they felt that a traditional macro-model would do exactly the same job’ (Staff economist 5, interview). Even more concerning, the core-non-core empirical strategy was increasingly deemed unsuitable to the forecasting function of BEQM. ‘Because we had this core-non-core structure, it was more difficult to provide narratives to the MPC. When we tried to decompose forecasts, it was difficult to say what was driving them: Was it the core model? Was it the non-core?’, a modeller explains (Staff economist 2,

interview). Materiality also mattered: the calibration of the core model proved time-consuming, mainly because of the number of parameters (*ibid.*).

In widening the missions and instruments of the Bank, the Great Financial Crisis both highlighted and increased the feeling that BEQM had become irrelevant to fulfilling the Bank’s mission. The first consequence of the crisis was that the Bank rate hit zero a few months after the collapse of Lehman Brothers. In March 2009, the BoE thus added the asset-purchase facility to its monetary policy toolkit and began to perform ‘quantitative easing’ (QE). The transmission channels whereby QE operated—portfolio adjustments and stabilisation of banks’ balance sheets—were not modelled by BEQM. The model could neither help decide whether to pursue QE nor guide its implementation. It was also useless to understand which mechanisms created financial instability, at a time the BoE was set to recover the macro- and microprudential oversight mandate that it had lost just as it was granted independence in 1997.⁴² BEQM’s helplessness was later encapsulated by a modeller:

Especially during the financial crisis, when all the mechanisms we were trying to understand were not in the core [model], the marginal economic benefit of the core was less and less apparent, and the model was not adding much to the thinking about the economic mechanisms (Staff economist 4, interview).

Plans to replace BEQM were thus rolled out beginning in the Fall of 2009. The staff decided to start with building a smaller model, nicknamed “baby BEQM” (Staff

⁴² Its financial stability mandate and associated supervision duties had been transferred to the Financial Services Authority, which began its operation in 2001. See Acosta et al. (2024). The 2012 Bank Act transferred it back to the BoE and led to the creation of a Financial Stability Committee.

economists 2 and 3, interview). It was completed in a few months by Harrison & Oomen (2010). While this initial downsizing might be reminiscent of the dynamics that occurred in the 1990s with MTMM (*cf.* Section_3), the underlying rationale was significantly different. First, this time the key economic mechanisms (in particular of what drove inflation) were preserved. Second, while the 1990s downsizing was largely imposed by King, the 2010s one was largely a result of modellers' agency.

After the development of 'baby BEQM', a larger team worked full time to develop COMPASS, following the same lines; the final version was completed in about 18 months. Except for Harrison, the team leader, the main contributors were 'newcomers', i.e. economists who had not been previously involved with building or operating BEQM (Burgess et al., 2013, i).⁴³ Unlike the BEQM team, the new modellers had almost all completed a PhD, and several had been trained abroad.⁴⁴ This standardised international training partly explains the theoretical and empirical structure of COMPASS.

COMPASS was estimated using Bayesian techniques. It was formally very different from BEQM and its core-non-core strategy. Its theoretical underpinnings were much closer than BEQM's to what had become, by the late 2000s, the standard for DSGE models in academia and central banks. However, the key economic mechanisms

⁴³ This resulted from the arrangement for new resources for building a new model: the team developing COMPASS was built by taking in new staff, while the existing modelling unit was in charge of operating the forecasting routine. Of course, the whole modelling team was still associated with the discussions about the development of COMPASS.

⁴⁴ Charlotta Groth held a PhD from Stockholm (2002), Francesca Monti from Université Libre de Bruxelles (2011); Emilio Fernandez-Corugedo was trained at University of Bristol (PhD 1999) and Konstantinos Theodoridis at Cardiff (PhD 2006).

embodied in COMPASS remained the same as in the BEQM core model (output-gap-driven inflation, arising from real and nominal adjustment frictions to exogenous shocks). Like BEQM, COMPASS does not include any sophisticated representation of the functioning of financial markets, the banking system, households' and firms' portfolio choices, etc.

Theoretical modelling choices made for COMPASS may thus seem paradoxical. The model grew out of BoE executives', academic macroeconomists' and the staff's discontent with BEQM, as well as from its inability to help the BoE understand and properly respond to the Great Financial Crisis. And yet, COMPASS did not embody a financial sector or the monetary policy transmission mechanisms at work in the implementation of Quantitative Easing. But here laid the major break from BEQM: COMPASS was not designed as a standalone model. As the official model documentation clearly highlighted, COMPASS was conceived as embedded in a whole *suite* of models. As previously explained, the 'suite of models' had previously been advertised by King's modellers, but some considered that it had largely remained a rhetorical deceit. Conversely, the suite presented by (Burgess et al., 2013, p. 39) consisted of at least 50 different models, with models being 'added or removed' depending on the context (*ibid.*, ii). Some of them provided forecasts for economic variables that are not included in COMPASS, and other 'alternative forecasts' for included variables.

The first class of models provided insights into key economic mechanisms left out from COMPASS, for instance, financial frictions and unconventional monetary policies (Burgess et al., 2013, p. 40). The second class of models in the suite provided forecasts for financial variables that were not included in COMPASS. The main model from this class, nicknamed the Balance-Sheet Model (BSM), is a large (140-variables) statistical

model. It is based on modelling developed in the early 2000s within the Financial Stability Directorate to produce the Financial Stability Review ([Benito et al., 2001](#)). Finally, the third class of models in the suite consists of alternative specifications of inflation and other variables to forecast. These alternative specifications are either driven by alternative theories (e.g. ‘Keynesian consumption functions’, ‘financial accelerator’, ‘Tobin-Q’) or by purely statistical (VAR-type) considerations. These alternative forecasts are combined through model averaging techniques, which were already developed in the early 2000s under the leadership of Simon Price ([Kapetanios et al., 2006, 2008](#)).

The 2011 published presentation of COMPASS exemplified how the financial crisis spurred another shift in the modelling culture of the BoE. The COMPASS team emphasised that ‘no canonical model in the academic literature [...] articulates all of the effects of the financial sector on the wider economy [...]’ ([Burgess et al., 2013, p. 40](#)), so that they choose to combine different frameworks to address these questions. The suite would include, for instance, extended versions of the core COMPASS DSGE model (introducing ‘credit spread’, i.e. a wedge between the policy interest rate and the cost of borrowing for economic agents), as well as VAR statistical models (e.g. [Barnett & Thomas, 2014](#)). The BoE modellers’ stance is consistent with the larger post-crisis intellectual shifts in central banking macroeconomic modelling. As explained by Smets ([2021, p. 3](#)), the author of the benchmark DSGE model and a former director general economics at the European Central Bank, central banking economists have long oscillated between the ‘core model’ and the ‘suite of models’ approach. The former allows policymakers to become more familiar with the model and to achieve a higher degree of consistency but creates a risk of ‘seeing everything through one lens.’ The latter helps tailor models to specific objectives and ‘improves the degree of policy

robustness’ but is more discretionary. After a period of dominance of core models, the pendulum may have swung back to suites.⁴⁵

The Great Financial Crisis and the resulting institutional transformations in the Bank’s functions and organisation may have played a role of catalyst. However, the intellectual context of modelling in academia and central banks constituted a significant indirect institutional constraint on modellers’ choices. In daily modelling practices within the Bank, dissatisfaction and material constraints regarding BEQM gave modellers incentive to promote the building of a new model.

Concluding remarks

The history of modelling at the BoE, as recounted in this paper, makes a case for considering the multiple forces at play in model building in policymaking institutions, in line with the existing literature analysing the nature and functions of models (Boumans, 1999; Morgan & Knuuttila, 2012) and in the history of macroeconomics (Boumans & Duarte, 2019). Moreover, our case study contributes to build, within this literature, an understanding of model *change and persistence*—an issue that has been forcibly raised, within and outside economics, following the Great Financial Crisis.

⁴⁵ See also Blanchard (2018) and Rodrik (2015)’s rules. The rise of suites of models in economic organisations required the development of a whole new information technology infrastructure. The BoE was no exception. The operation of COMPASS was underpinned by the launch of an new user interface called EASE (Economic Analysis and Simulation Environment), of a software that allowed for BoE staff to solve and estimate the various models under MATLAB, one called MAPS (Burgess et al., 2013). It paralleled the launch of a new version of DYNARE (Cherrier et al., 2023) and of the YADA software at the European Central Bank.

With respect to model change and persistence, we find that there was no unique or recurrent pattern in the factors that resulted in the decision to change (or not) a model at the Bank. Each time, model replacement resulted from a different combination of factors: sometimes modellers' agency drove most of the modelling choices (as in the case of the monetarist episode); sometimes institutional factors play a decisive role: policymakers, academics and other central banks shaped modelling choices (directly for policymakers, indirectly for the two others, as in the MTMM and in the BEQM/COMPASS episodes); sometimes the materiality of models, tied to the resources needed to develop and run these models, proved a particularly binding constraint (as in the monetarist episode also).

Moreover, our case study documents how modelling within policymaking institutions involves more dimensions than “just” discussions about economic theory or empirical performance. In particular, none of our sources suggest that poor performance in terms of forecasting was ever the impetus for a change of model. This forcefully contradicts some preconceived ideas on model change (for instance, that large-scale, Keynesian-inspired macroeconomic models of the 1970s were dismissed because of their inability to predict stagflation, or because of their theoretical inadequacies with respect to new, raising academic standards). Material factors, which made the issues of the model size and its tractability salient ([Cherrier, 2023](#)), often took a considerable place in the discussions between BoE modellers and policymakers; likewise, empirical strategies and complementarity across models (e.g. central models vs. satellite models) were important drivers in determining modelling choices. For instance, in the BEQM/COMPASS episodes, we have highlighted how discussions and dissatisfaction with the empirical strategy (BEQM's core-non-core approach) took at least equal, if not

greater, importance than its adequacy with theoretical DSGE standards practised in academia and other central banks.

Overall, by outlining three general types of factors (the agency of modellers, institutional factors, and the material factor) at play in modelling decisions, our article provides a general framework for analysing model change and persistence in policymaking institutions. Further research, applying this framework to other case studies, would contribute to a more comprehensive and systematic analysis of why and how economists build and use models.

References

- Acosta, J. C., & Cherrier, B. (2021). The Transformation of Economic Analysis at the Board of Governors of the Federal Reserve during the 1960s. *Journal of the History of Economic Thought*, 43(3), 323–349.
- Acosta, J.C., Rancan, A., & Sergi, F. (2023). Multi-Country Modelling at the Commission of the European Communities: Centralised and Decentralised Approaches. *European Economic Review*, 158, 104564.
<https://doi.org/10.1016/j.euroecorev.2023.104564>
- Acosta, J. C., Claveau, F., Cherrier, B., Fontan, C., Goutsmedt, A., & Sergi, F. (2024). Six Decades of Economic Research at the Bank of England. *History of Political Economy*, 56(1). <https://doi.org/10.1215/00182702-10956544>
- Alvarez-Lois, P., Harrison, R., Piscitelli, L., & Scott, A. (2008). On the application and use of DSGE models. *Journal of Economic Dynamics and Control*, 32(8), 2428–2452.
- Arestis, P., & Sawyer, M. (2002). The Bank of England macroeconomic model: Its nature and implications. *Journal of Post Keynesian Economics*, 24(4), 529–545.

- Backhouse, R. E., Forder, J., & Laskaridis, C. (2023). The natural rate of unemployment and the NAIRU. *European Economic Review*, 159, 104563.
- Ball, J., & Holly, S. (1991). Macroeconometric Model-Building in the United Kingdom. In R. G. Bodkin, L. R. Klein, & K. Marwah (Eds.), *A history of macroeconometric model-building*. E. Elgar.
- Ban, C. (2015). Austerity versus Stimulus? Understanding Fiscal Policy Change at the International Monetary Fund Since the Great Recession. *Governance*, 28(2), 167–183.
<https://doi.org/10.1111/gove.12099>
- Barnett, A., & Thomas, R. (2014). Has weak lending and activity in the UK been driven by credit supply shocks? *The Manchester School*, 82, 60–89.
- Barrell, R., Blake, A., & Young, G. (2018). Macroeconomic modelling at the Institute: Hopes, challenges and a lasting contribution. *National Institute Economic Review*, 246(1), R3–R14.
- Batini, N., Harrison, R., & Millard, S. P. (2003). Monetary policy rules for an open economy. *Journal of Economic Dynamics and Control*, 27(11-12), 2059–2094.
- Bayoumi, T. (Ed.). (2004). *GEM: A new international macroeconomic model*. International Monetary Fund.
- Benito, A., Whitley, J., & Young, G. (2001). Analysing corporate and household sector balance sheets. *Financial Stability Review*, 11, 160–174.
- Best, J. (2020). The quiet failures of early neoliberalism: From rational expectations to Keynesianism in reverse. *Review of International Studies*, 46(5), 594–612.
<https://doi.org/10.1017/S0260210520000169>
- Best, J. (2021). Varieties of ignorance in neoliberal policy: Or the possibilities and perils of wishful economic thinking. *Review of International Political Economy*, 29(4), 1–25.

- Blanchard, O. (2018). On the future of macroeconomic models. *Oxford Review of Economic Policy*, 34(1-2), 43–54. <https://doi.org/10.1093/oxrep/grx045>
- Boumans, M. (1999). Built-in justification. In M. S. Morgan & M. Morrison (Eds.), *Models as Mediators-Perspectives on Natural and Social Science* (pp. 66–96). Cambridge University Press.
- Boumans, M. (2005). *How economists model the world into numbers*. Routledge.
- Boumans, M., & Duarte, P. G. (2019). The History of Macroeconometric Modeling: An Introduction. *History of Political Economy*, 51(3), 391–400.
- Braun, B. (2014). Why Models Matter: The Making and Unmaking of Governability in Macroeconomic Discourse. *Journal of Critical Globalisation Studies*, 7, 48–79.
- Britton, E., Butler, J. E., Whitley, J. D., & Dhar, S. K. (1996). An Introduction to the bank of England Macroeconomic Model. *Bank of England Internal Document*.
- Britton, E., Fisher, P., & Whitley, J. (1998). The Inflation Report projections: Understanding the fan chart. *Bank of England Quarterly Bulletin*, 1998(February), 30–37.
- Burgess, S., Fernandez-Corugedo, E., Groth, C., Harrison, R., Monti, F., Theodoridis, K., & Waldron, M. (2013). The Bank of England’s Forecasting Platform: COMPASS, MAPS, EASE and the Suite of Models. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2266506>
- Cherrier, B. (2023). The Price of Virtue: Some Hypotheses on How Tractability Shaped Economics. *Æconomia. History, Methodology, Philosophy*, 13(1), 23–48.
- Cherrier, B., & Backhouse, R. (2019). The Ordinary Business of Macroeconometric Modeling: Working on the Fed-MIT-Penn Model, 1964-1974. *History of Political Economy*, 51(3), 425–447. <https://doi.org/10.31235/osf.io/39xkz>

- Cherrier, B., Saïdi, A., & Sergi, F. (2023). ““Write Your Model Almost as You Would on Paper and Dynare Will Take Care of the Rest!””. *Æconomia. History/Methodology/Philosophy*, *Forthcoming*.
- Christiano, L. J., Eichenbaum, M., & Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy*, *113*(1), 1–45.
- Clarida, R., Galí, J., & Gertler, M. (1998). Monetary Policy Rules in Practice: Some International Evidence. *European Economic Review*, *42*, 1033–1067.
- Clift, B. (2019). The hollowing out of monetarism: The rise of rules-based monetary policy-making in the UK and USA and problems with the paradigm change framework. *Comparative European Politics*, *18*(3). <https://doi.org/10.1057/s41295-019-00186-1>
- Coghlan, R. (1979). A Small Monetary Model of the UK Economy. *Bank of England Discussion Papers*, *3*.
- Coman, R. (2019). Transnational Economists in the Eurozone Crisis: Professional Structures, Networks and Ideas. *New Political Economy*, *25*(6), 1–14. <https://doi.org/10.1080/13563467.2019.1669547>
- Cooley, T. F. (Ed.). (1995). *Frontiers of business cycle research*. Princeton University Press.
- De Vroey, M. (2016). *A History of Macroeconomics from Keynes to Lucas and Beyond*. Cambridge University Press.
- den Butter, F. A. G., & Morgan, M. S. (2003). *Empirical Models and Policy Making: Interaction and Institutions* (1st ed.). Routledge.
- Dhar, S., Pain, D., & Thomas, R. (2000). A small structural empirical model of the UK monetary transmission mechanism. *Bank of England Working Papers*, *113*.

- DiCecio, R., & Nelson, E. (2013). The great inflation in the United States and the United Kingdom: Reconciling policy decisions and data outcomes. In *The Great Inflation: The Rebirth of Modern Central Banking* (pp. 393–438). University of Chicago Press.
- Dicks-Mireaux, L. A. (1975). Discussion on Econometric Models. In G. A. Renton (Ed.), *Modelling the economy* (pp. 125–126). Heinemann Educational Books.
- Elgie, R., & Thompson, H. (1998). *The politics of central banks*. Routledge.
- Erceg, C. J., Guerrieri, L., & Gust, C. (2005). SIGMA: A New Open Economy Model for Policy Analysis. *International Finance Discussion Papers*, 835, 53.
- Fourcade, M. (2009). *Economists and societies: Discipline and profession in the united states, britain, and france, 1890s to 1990s*. Princeton University Press.
- Frenkel, J. A., & Johnson, H. G. (Eds.). (1976). *The monetary approach to the balance of payments*. G. Allen & Unwin.
- Friedman, M. (1968). The Role of Monetary Policy. *The American Economic Review*, 58(1), 1–17. <https://www.jstor.org/stable/1831652>
- Friedman, M. (1970). *The counter-revolution in monetary theory: First Wincott memorial lecture, delivered at the Senate House, University of London, 16 September, 1970*. Institute of Economic Affairs.
- Friedman, M., & Schwartz, A. J. (1963). *A Monetary history of the United States 1867-1960*. Princeton university press.
- Goodhart, C. A. E. (1984). *Monetary theory and practice: The UK-experience*. Macmillan International Higher Education.
- Goutsmedt, A. (2019). Macroeconomics at the Crossroads: Stagflation and the Struggle between" Keynesian" and New Classical Macroeconometric Programs. *Working Paper of the Centre d'Economie de La Sorbonne*. <https://doi.org/10.1215/00182702-7551912>

- Goutsmedt, A., Pinzon-Fuchs, E., Renault, M., & Sergi, F. (2019). Reacting to the lucas critique: The keynesians' replies. *History of Political Economy*, 51(3), 533–556.
<https://doi.org/https://shs.hal.science/halshs-01625188/>
- Goutsmedt, A., & Rubin, G. (2018). Robert J. Gordon and the introduction of the natural rate hypothesis in the Keynesian framework. *History of Economic Ideas*, 26(3), 157–187.
- Gürkaynak, R., & Tille, C. (2017). *DSGE Models in the Conduct of Policy: Use as intended*. CEPR Press.
- Haldane, A. (2012). What have the economists ever done for us? In *VoxEU.org*.
- Hall, S. G., & Henry, S. G. B. (2018). Macro Modelling at the NIESR: Its Recent History. *National Institute Economic Review*, 246(1), R15–R23.
- Halsmayer, V. (2017). A Model to “Make Decisions and Take Actions”: Leif Johansen’s Multisector Growth Model, Computerized Macroeconomic Planning, and Resilient Infrastructures for Policymaking. *History of Political Economy*, 49(Supplement), 158–186.
- Halsmayer, V. (2018). Following Artifacts. *History of Political Economy*, 50(3), 629–634. <https://doi.org/10.1215/00182702-7023590>
- Harnett, I., Robinson, G., Ryding, J., & Patterson, K. (1987). The Bank of England quarterly model of the UK economy. *Economic Modelling*, 4(4), 398–528.
[https://doi.org/10.1016/0264-9993\(87\)90012-5](https://doi.org/10.1016/0264-9993(87)90012-5)
- Harris, M. N., Levine, P., & Spencer, C. (2011). A decade of dissent: Explaining the dissent voting behavior of Bank of England MPC members. *Public Choice*, 146(3-4), 413–442. <https://doi.org/10.1007/s11127-010-9597-6>
- Harrison, R., Nikolov, K., Quinn, M., Ramsay, G., Scott, A., Thomas, R., & Bank of England (Eds.). (2005). *The Bank of England quarterly model*. Bank of England.

- Harrison, R., & Oomen, O. (2010). Evaluating and estimating a DSGE model for the United Kingdom. *Bank of England Working Papers*, 380.
- Heimberger, P., Huber, J., & Kapeller, J. (2020). The power of economic models: The case of the EU's fiscal regulation framework. *Socio-Economic Review*, 18(2), 337–366. <https://doi.org/10.1093/ser/mwz052>
- Helgadóttir, O. (2021a). How to make a super model: Professional incentives and the birth of contemporary macroeconomics. *Review of International Political Economy*, 30(1), 1–29. <https://doi.org/10.1080/09692290.2021.1997786>
- Helgadóttir, O. (2021b). Seeing like a macroeconomist: Varieties of formalisation, professional incentives and academic ideational change. *New Political Economy*, 27(3), 1–15. <https://doi.org/10.1080/13563467.2021.1967910>
- Helgadóttir, O., & Ban, C. (2021). Managing Macroeconomic Neoliberalism: Capital and the Resilience of the Rational Expectations Assumption since the Great Recession. *New Political Economy*, 1–16. <https://doi.org/10.1080/13563467.2020.1863344>
- Hendry, D. F., & Ericsson, N. R. (1991). An Econometric Analysis of UK Money Demand In Monetary Trends in the United States and the United Kingdom by Milton Friedman and Anna J. Schwartz. *American Economic Review*, 81(1), 8–38. <https://doi.org/10.17016/IFDP.1989.355>
- Hendry, D. F., & Muellbauer, J. N. J. (2018). The future of macroeconomics: Macro theory and models at the Bank of England. *Oxford Review of Economic Policy*, 34(1-2), 287–328. <https://doi.org/10.1093/oxrep/grx055>
- Henriksen, L. F. (2013). Economic models as devices of policy change: Policy paradigms, paradigm shift, and performativity. *Regulation & Governance*, 7(4), 481–495.

- Holland, A., & Scott, A. (1998). The determinants of UK business cycles. *The Economic Journal*, 108(449), 1067–1092.
- Hoover, K. D. (2012). Microfoundational programs. In P. G. Duarte & G. T. Lima (Eds.), *Microfoundations Reconsidered* (pp. 19–61). Edward Elgar Publishing.
- Hunt, B., Rose, D., & Scott, A. (2000). The core model of the Reserve Bank of New Zealand's forecasting and policy system. *Economic Modelling*, 17(2), 247–274.
- Ingrao, B., & Sardoni, C. (2019). *Banks and Finance in Modern Macroeconomics*. Edward Elgar Publishing. <https://doi.org/10.4337/9781786431530>
- James, H. (2020). *Making a Modern Central Bank: The Bank of England 1979*. Cambridge University Press.
- Kapetanios, G., Labhard, V., & Price, S. (2006). Forecasting using predictive likelihood model averaging. *Economics Letters*, 91(3), 373–379.
- Kapetanios, G., Labhard, V., & Price, S. (2008). Forecast combination and the Bank of England's suite of statistical forecasting models. *Economic Modelling*, 25(4), 772–792.
- Kay, J. A., & King, M. A. (2020). *Radical Uncertainty*. The Bridge Street Press.
- Kydland, F.E. & Prescott, E.C., (1982). Time to build and aggregate fluctuations. *Econometrica*, 50(6): 1345–1370.
- King, M. A. (1997). The Inflation Target five years on - Lecture delivered. *Speech at the LSE*, 26.
- Kuorikoski, J., & Lehtinen, A. (2018). Model selection in macroeconomics: DSGE and ad hocness. *Journal of Economic Methodology*, 25(3), 1–13.
<https://doi.org/10.1080/1350178X.2018.1488563>
- Kynaston, D. (2017). *Till Time's Last Sand: A History of the Bank of England 1694-2013*. Bloomsbury Publishing.

- Latter, A. R. (1979). Bank of England model of the UK economy. *Bank of England Discussion Paper*.
- Long, J. B., Jr., & Plosser, C. I. (1983). Real Business Cycles. *Journal of Political Economy*, 91(1), 39–69. <https://www.jstor.org/stable/1840430>
- Lucas, R. (1976). Econometric Policy Evaluation: A Critique. *Carnegie- Rochester Conference Series on Public Policy*, 1, 19–46.
- Maas, H., Mata, T., & Davis, J. B. (2011). Introduction: The history of economics as a history of practice. *The European Journal of the History of Economic Thought*, 18(5), 635–642. <https://doi.org/10.1080/09672567.2011.632891>
- MacKenzie, D. A., Muniesa, F., & Siu, L. (Eds.). (2007). *Do Economists Make Markets?: On the Performativity of Economics*. Princeton University Press.
- Mäki, U. (2005). Models are experiments, experiments are models. *Journal of Economic Methodology*, 12(2), 303–315. <https://doi.org/10.1080/13501780500086255>
- Mehrling, P. (2010). *The New Lombard Street: How the Fed Became the Dealer of Last Resort*. Princeton University Press.
- Millard, S., Scott, A., & Sensier, M. (1997). The labour market over the business cycle: Can theory fit the facts? *Oxford Review of Economic Policy*, 13(3), 70–92.
- Morgan, M. S. (2012). *The World in the Model: How Economists Work and Think*. Cambridge University Press.
- Morgan, M. S., & Knuuttila, T. (2012). Models and Modelling in Economics. In U. Mäki (Ed.), *Philosophy of Economics, 1st Edition* (pp. 49–87). Elsevier.
- Morgan, M. S., & Morrison, M. (1999). *Models as mediators: Perspectives on natural and social science*. Cambridge University Press.

- Morgan, M. S., & Stapleford, T. A. (2023). Narrative in Economics: A New Turn on the Past. *History of Political Economy*, 55(3), 395–421. <https://doi.org/10.1215/00182702-10438855>
- Mudge, S. L., & Vauchez, A. (2018). Too Embedded to Fail. *Historical Social Research/Historische Sozialforschung*, 43(3 (165), 248–273.
- Needham, D. (2014). *UK Monetary Policy from Devaluation to Thatcher, 1967-82*. Palgrave Macmillan.
- Nelson, E., & Nikolov, K. (2004). Monetary Policy and Stagflation in the UK. *Journal of Money, Credit, and Banking*, 36(3), 293–318. <https://doi.org/10.1353/mcb.2004.0058>
- Pagan, A. (2003). Report on modelling and forecasting at the Bank of England/Bank's response to the Pagan report. *Bank of England. Quarterly Bulletin*, 43(1), 60–88.
- Pagan, A. (2005). Addendum to Report on Modelling and Forecasting at the Bank of England. *Bank of England Quarterly Bulletin*, 44(2), 190–193.
- Peacock, A. (1975). Foreword. In G. A. Renton (Ed.), *Modelling the Economy: Based on Papers Presented at the Social Science Research Council's Conference on Economic Modelling at the London Graduate School of Business Studies*. Heinemann Educational Publishers.
- Pinzón-Fuchs, E. (2017). *Economics as a 'Tooled' Discipline: Lawrence R. Klein and the Making of Macroeconometric Modeling, 1939-1959* [PhD thesis]. Université Paris I Panthéon-Sorbonne.
- Rancan, A. (2020). The “Place of the Phillips Curve” in Macroeconometric Models: The Case of the Fed Board's Model (1966-1980s). *Journal of the History of Economic Thought*, 44(2), 161–181.
- Rodrik, D. (2015). *Economics Rules: Why Economics Works, When It Fails, and How To Tell The Difference*. OUP Oxford.

- Romer, P. (2016). The trouble with macroeconomics. -.
- Sims, C. A. (2008). Improving monetary policy models. *Journal of Economic Dynamics and Control*, 32(8), 2460–2475.
- Smets, F. (2021). Macroeconomic Modelling at the European Central Bank. *Communication at the Royal Economic Society Conference*.
- Smets, F., & Wouters, R. (2003). An estimated dynamic stochastic general equilibrium model of the euro area. *Journal of the European Economic Association*, 1(5), 1123–1175.
- Smith, D. (1987). *The rise and fall of monetarism*. Penguin Books.
- Smith, R. (2003). Emergent policy-making with macroeconometric models. In *Empirical Models and Policy Making: Interaction and Institutions* (pp. 244–256).
- Snowdon, B., & Vane, H. R. (2005). *Modern macroeconomics: Its origins, development and current state*. Edward Elgar.
- Stapleford, T. A. (2017). Historical Epistemology and the History of Economics: Views Through the Lens of Practice. In *Symposium on the Historical Epistemology of Economics* (Vol. 35A, pp. 113–145). Emerald Publishing Limited.
- <https://doi.org/10.1108/S0743-41542017000035A007>
- Stiglitz, J. E. (2011). Rethinking macroeconomics: What failed, and how to repair it. *Journal of the European Economic Association*, 9(4), 591–645.
- <https://doi.org/10.1111/j.1542-4774.2011.01030.x>
- Sugden, R. (2000). Credible worlds: The status of theoretical models in economics. *Journal of Economic Methodology*, 7(1), 1–31.
- Vines, D., & Wills, S. (2018). The rebuilding macroeconomic theory project: An analytical assessment. *Oxford Review of Economic Policy*, 34(1-2), 1–42.
- <https://doi.org/10.1093/oxrep/grx062>

Wallis, K. F. (Ed.). (1984). *Models of the UK economy*. University Press.

Wallis, K. F., Andrews, M. J., Fisher, P. G., Longbottom, J. A., & Whitley, J. D. (1986).

Models of the UK economy : A third review by the ESRC macroeconomic modelling bureau. Oxford University Press.

Whitley, J. (1997). Economic models and policy-making. *Bank of England. Quarterly Bulletin*, 37(2), 163.