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**Institutions and uncertainty:
an empirical investigation**

A thesis
submitted in fulfilment
of the requirements for the degree
of
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at
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by
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Abstract

This thesis presents four papers on the role institutions (defined as Douglass North defined institutions) play in generating uncertainty. Specifically, we focus on how uncertainty changes as institutions change. The thesis is empirically focused. In answering our research questions, we employ, often in combination, tools from the ‘traditional’ econometric literature—in particular, structural vector autoregressions—and tools from the natural language processing literature.

Two of the papers in this thesis focus on New Zealand’s wide-ranging institutional reforms, which took place from the mid-1980s to the mid-1990. Drawing on the purpose Douglass North stated for institutions: ‘to reduce uncertainty in exchange’ (North, 1991a, p. 97), we argue that institutional reform is only successful if it lowers uncertainty. We find evidence that New Zealand’s reform lowered uncertainty in general (at least, from firms’ point of view), as well as uncertainty about tax and transfers. We also argue in this thesis that institutional change might affect not just the level of uncertainty but also its composition (in terms of the types of uncertainty experienced). Motivated by the ‘Mundellian trilemma’, we argue that if every monetary regime/ institutional setup is imperfect in its own way, then the types of uncertainty associated with the regime will be idiosyncratic. Based on an analysis of a large corpus of historical newspaper articles, using natural language methods, we find the different monetary regimes adopted by the United States and the United Kingdom since 1890 are generally idiosyncratic in terms of the types of uncertainty they generate.

In this thesis we also exploit the institutions—uncertainty link for another purpose: the identification of uncertainty shocks. A problem in research on the business cycle impact of uncertainty is finding movements in uncertainty that are plausibly exogenous to the business cycle (‘uncertainty shocks’). We narratively identify (using the New Zealand parliamentary record) a set of quarters where heightened uncertainty was the result of institutional or policy change, rather than the state of the business cycle. We use these quarters as instruments in a proxy structural vector autoregression to quantify the effect of uncertainty on output (amongst other variables). Comparing our results with the conventional recursive method for identifying uncertainty shocks, we find uncertainty shocks have a much larger impact on output. This suggests the estimates from the conventional recursive method suffer from attenuation bias.

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Chapter 1

Introduction

1.1 Why this research is important

The consequences of flawed institutions

Institutional frameworks ('institutions') are the rules of the game for political, economic, and social interaction. Like the rules of any game, institutions are humanly-devised constraints (North, 1991a). And as human constructs, institutions will have flaws. These flaws may be unclear, ill-conceived or inconsistent 'rules'; alternatively, the institution may lack mechanisms to enforce the 'rules'. Some institutions that function well in one time or place may be flawed in other times or places; other institutions may always be flawed. What, then, are the consequences of flawed institutions?

A relatively recent event—Britain's exit from the European Union ('Brexit')—provides a clue.

Britain's supposedly sovereign Parliament has voted against just such a no-deal Brexit on the ground [sic] that it would do the country grave harm. There will doubtless be more parliamentary machinations to stop a no-deal Brexit or force one through. The constitution is unclear on whether the executive or Parliament should prevail. It is unclear how to even choose between them.

Behind this uncertainty lies the fact that Britain's constitution is a jumble of contradictions scattered across countless laws, conventions and rules.¹

According to the author of the article, at least, the flawed institution in question—the British Constitution—does not clearly define the rules about where decision-making rights lie to decide if Britain can leave the European Union without a withdrawal agreement; as the quote notes, the result is uncertainty.

Institutions and uncertainty are intimately linked. Indeed, Douglass North, the founding father of institutional economics, argued the purpose of institutions was to reduce uncertainty: '[t]hroughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange' (North, 1991a, p. 97). Institutions that create uncertainty, such as the British constitution, are clearly not fulfilling their role as defined by North.

If institutions are creating uncertainty it is consequential because uncertainty is consequential. With risk and forecastable volatility—two concepts distinct from uncertainty but often confused—one can take actions, such as insurance and hedging, to mitigate the consequences.² Uncertainty, as characterised by the lack of quantifiable knowledge about probabilities of outcomes, is harder to mitigate. This means

¹*The next to blow*, The Economist, 1 June 2019.

²We use risk in Knightian sense: the outcome is not known but the odds of different outcomes are.

it can have quite detrimental effects on the economy. Households undertake precautionary saving when faced with uncertain future income; in particular, they are likely to delay durable consumption until their prospects become clearer. Firms undertaking irreversible investment are also more likely to wait and see (in a technical sense, they raise their investment threshold; see Dixit & Pindyck, 1994). Similarly, firms are more likely to wait and see before hiring as it is costly (in terms of time and money) to reverse (Bloom, 2014). Finally, uncertainty could mean lenders demand a 'risk' premium, increasing a firm's cost of finance (Gilchrist et al., 2014).

At a macroeconomic level, Bloom (2014) notes higher uncertainty can make investment less sensitive to monetary and tax policy changes: this makes stabilisation policy less effective. Further, Bloom (2014) notes that uncertainty slows resource reallocation, high-productivity (low-productivity) firms are less likely to expand (contract) as firms are less likely to be confident in relative price signals; this will result in lower potential output.³

Research on institutions and uncertainty

Uncertainty is generally detrimental to an economy and institutions and uncertainty are intimately linked. Surprisingly, however, this link has not been adequately researched. Part of the reason is, it appears, quantifying uncertainty is difficult. The empirical literature on institutions has thus explored other avenues, of which two are worth comment.

One major avenue is based on the premise that, while successful economic outcomes, such as a high level of GDP per capita, have their proximate cause in high levels of the capital stock and technological progress, the ultimate cause is well-functioning institutions (formal and informal), high social capital and beneficial geography. In addition to determining the relative role institutions play (as opposed to geography and social capital), the empirical literature has focused on finding which specific aspect(s) of institutional quality explains the cross-country variation in a particular 'target' variable(s) such as GDP, investment rates or health and education outcomes. The literature is large, but seminal studies include Acemoglu et al. (2001) and Hall and Jones (1999). More recently Lloyd and Lee (2018) provided a critical review of this body of work.

The role uncertainty plays in investment decisions is well studied (see Dixit & Pindyck, 1994, and Pindyck, 1991, for examples); therefore, it follows that uncertainty will be a mediating variable through which institutions operate to determine the capital stock and, ultimately, GDP. While a few papers have explicitly tried to empirically study how cross-country variations in institutions cause cross-country variations in *volatility* (for example, Acemoglu et al., 2003; Fatas & Mihov, 2013; Malik & Temple, 2009), there, to our knowledge, is no cross-country study of how uncertainty outcomes vary with institutional quality.⁴ While volatility and uncertainty are related, they are not identical. So the question arises: why the focus on volatility—a statistical measure of the dispersion? The answer, in short, appears to be that: uncertainty is harder to quantify.

³Uncertainty may have some positive effects. In relatively closed economies, if households precautionary save, there are more funds available for investment and interest rates will be lower. Secondly, conditional on the mean forecast of demand for products remaining the same, increased uncertainty increases the upside potential, while the downside remains the same: zero (this idea is called 'growth options'; Bar-Ilan & Strange, 1996). The Oi–Hartman–Abel effect argues something similar: downside outcomes can be insured against, but the upside outcomes are large (Bloom, 2014).

⁴Other studies have looked at the determinants of institutional uncertainty (see Brunetti & Weder, 1998)

A second avenue of research on institutions we wish to note focuses on understanding if a reform of institutions in a particular country, or set of countries, has ‘improved’ (however defined) in a particular ‘target’ variable(s) such as GDP, employment etc (for example, recent studies include Bordon et al., 2016, de Haan & Wiese, 2020 and Duval & Furceri, 2018).⁵ Generally, uncertainty has been ignored as a ‘target’ variable, although it is sometimes acknowledged as being a mediating variable (see Bolen & Williamson, 2019). In terms of what has been done, as with cross-country studies, studies of institutional reform have tended to focus on volatility, rather than uncertainty (again, for example, Bolen & Williamson, 2019). As we note in chapter two, the studies that have focused on uncertainty and institutions have either used small-scale surveys (Borner et al., 1995) or focused on one narrow aspect of uncertainty (such as the impact of inflation targeting/ central bank independence on inflation uncertainty; e.g. Boero et al., 2008; Lawton & Gallagher, 2020.) Again, the lack of study of the impact of institutional reform on uncertainty probably reflects the lack of good measures of uncertainty.

The Global Financial Crisis (the GFC) spurred research on the business cycle effects of uncertainty.⁶ In studying these questions, the recent uncertainty literature has benefited from a proliferation of data (in numerical and textual forms), together with advances in computing power and statistical methods. The business cycle effects of uncertainty literature is large, but is well surveyed by Bloom (2014) and Castelnuovo et al. (2017). The development of new measures of uncertainty in the business cycle literature represents an opportunity to study the institutional/uncertainty relationship; an opportunity we seize.⁷

1.2 The contribution of this thesis and research questions

There is clearly an opportunity, using the new and better measures of uncertainty developed in the literature since the GFC, to better understand the link between uncertainty and institutions. In terms of the two avenues of empirical institutions research we outlined above, we are focused, in the main, on contributing to understanding how institutional change/reform leads to changes in uncertainty. In focusing on this area, we decided to limit the size of the task we faced. We believe that understanding what determines the cross-country variation in uncertainty outcomes represents valuable future research.

Before we set out our research questions, let us return to North’s quote for a moment: ‘[t]hroughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange’ (North, 1991a, p. 97). If humans *create* institutions to reduce uncertainty, does it not follow that if humans are *reforming* institutions with the purpose of improving them, then the most relevant question is did the reform lower uncertainty? Evaluating institutional reform without looking at uncertainty misses an important causal link. And this may lead to erroneous conclusions about the success, or otherwise, of the reform. This is because, while a

⁵There are many of these such studies. In terms of the New Zealand reform of the mid-1980s to the mid-1990s, which is the set of reforms we study, studies include Dalziel (2002), Silverstone et al. (1996) and Evans et al. (1996).

⁶Of course, economists have understood and written about uncertainty for a long time. Important contributions were made by Keynes (1936), Bernanke (1983) and Dixit and Pindyck (1994), for example

⁷The business cycle uncertainty literature again has largely ignored the role institutional quality plays, although two papers have pointed out that uncertainty shocks have larger impacts on output in countries with lower institutional quality (Carrière-Swallow & Céspedes, 2013; Trung, 2019)

reduction in uncertainty will ultimately benefit the macroeconomic aggregates typically focused on (for example, GDP, fiscal balances), these variables can be affected by other factors—developments in key export and financial markets, for example. We argue a focus on uncertainty, the mediating variable through which institutional reform should improve economic outcomes, will give the best indication of the reform's success.

Our specific empirical application is assessing the success of a wide-ranging institutional reform in New Zealand that took place from mid-1984 to 1995. The application is interesting for two reasons. The first reason is, although most OECD countries reformed their institutions over the period, no other country went as far as New Zealand (see Henderson, 1995). The second reason is there is still debate about whether New Zealand's reforms can be seen as a success (see Evans et al., 1996 and Dalziel, 2002 for contrasting views). Therefore our first research question is: **were New Zealand's reforms successful in lowering uncertainty?**

As well as changing the level of uncertainty, a different institutional structure—different rules—might change the composition of uncertainty. We use the evolution of monetary institutional regimes in the United States and the United Kingdom since 1890 as our application. We feel this is an interesting application because the so-called open-economy trilemma—the inability of an open economy to simultaneously have a fixed exchange rate, free capital flows and autonomous monetary policy—means different institutional structures involve different tradeoffs in terms of what objectives can be achieved. It follows that the relative contributions of exchange rate, capital and monetary policy (to name a few examples) to uncertainty may differ at different points in time as different objectives are targeted. Therefore our second research question is this: **do different monetary institutional regimes result in different types of uncertainty?**

If we are correct that institutional reform could result in changes in uncertainty, it raises the interesting implication that institutional change is a plausible source of exogenous (to the business cycle) uncertainty (at least contemporaneously). One challenge of researching the business cycle effects of uncertainty is identifying (or isolating) such exogenous movements in uncertainty from the movements in uncertainty coming from the business cycle itself. Making use of institutional change to identify these exogenous uncertainty movements seems a sensible undertaking from our point of view. Our third research question is thus: **given the simultaneity between uncertainty and the business cycle, can we use the fact—that in some time periods, institutional change might induce uncertainty exogenous to the business cycle—to better identify uncertainty shocks and thus better understand the impacts of uncertainty on the economy?** Our specific application in this instance is, again, New Zealand. The reasons for focusing on New Zealand are twofold. One, the significant reform the country went through from the mid-1980s represents a potential period of exogenous uncertainty. Two, there are high-quality data to construct uncertainty measures for the reform period.

1.3 Thesis outline

The remainder of this thesis is structured as follows. Chapter two examines if New Zealand's institutional reform of the mid-1980s to mid-1990s was successful in lowering uncertainty. Chapter three examines if a specific institutional change undertaken as part of the New Zealand reform—the legalisation governing the conduct

of fiscal policy and fiscal management: the Public Finance Act (1989) and Fiscal Responsibility Act (1994)—was successful in lowering uncertainty about fiscal policy.

Chapter four examines if different monetary regimes—from the classical gold standard to the modern inflation targeting regime with free-floating exchange rates and free-flowing capital—have resulted in changing the composition of uncertainty.

Chapter five presents research where periods of institutional change are used to identify uncertainty shocks that are exogenous to the business cycle. We compare the measured impact of uncertainty on the business cycle when uncertainty shocks are identified using this method to the most common method identification in the literature: recursive identification. Our results suggest that the estimates of the effect of uncertainty on the business cycle suffer from attenuation bias if recursive identification is used.

Chapter six concludes and outlines suggestions for further research.

As we note below the chapters are standalone. The reason for this is they will be submitted for publication. As such, the relevant literature is identified in each of the chapters and, thus, we refrain from a separate literature review chapter. To make referring to them easier, we have, however, put all the references in one final section.

1.4 Publications

1. The paper presented as Chapter two in this thesis was presented to the 2021 NZAE PhD conference and published as Waikato University Economics Discussion Paper 20/11. It will be submitted for journal publication soon.
2. The paper presented as Chapter five in this thesis was presented to the 2020 NZAE PhD conference and published as Waikato University Economics Discussion Paper 20/10. It will be submitted for journal publication soon.
3. The paper presented as Chapter three was presented at the NZAE conference in June. Prior to then, it will be disseminated as a working paper. We are currently preparing it for journal publication.
4. Chapter four, on monetary regimes and uncertainty, will be shortened and an outlet(s) found for the work to be presented at. It is also intended that a paper (or two) from this chapter is published.

Chapter 2

Does reforming economic institutions reduce uncertainty? Evidence from New Zealand

Abstract

This paper begins with a brief narrative on the close conceptual relationship between institutions and uncertainty, which motivates using uncertainty as a metric of institutional reform success in the subsequent econometric analysis. Our analysis, based on using uncertainty measures constructed on firm-level data in a Bayesian Structural AutoRegression model, suggests that while during the reform period uncertainty increased, New Zealand's wide-ranging institutional reform in the late 20th century (approximately 1984 to 1995) was eventually successful in lowering uncertainty from domestic institutional sources. We also contend that rising uncertainty immediately prior to reform could have been the spur to reform. Given New Zealand was one of many OECD countries that pursued market-oriented economic institutional reform over the period, our results have insights beyond just understanding the New Zealand experience.

JEL codes: C32, E02, O43, O56

Keywords: Institutions, economic reform, uncertainty, New Zealand

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Disclaimer

The results and views presented in this study are the work of the author, not NZIER.

2.1 Introduction

The high economic and social costs of reforming economic institutions compels a given reform to be successful. Typically reform success is measured by comparing the post-reform level of certain macroeconomic variables (such as GDP, employment, inflation and balance of payments deficits) to their pre-reform level.¹

This paper posits that the level of uncertainty should be considered in assessing the success of institutional reform. This claim reflects the close relationship between institutions and uncertainty. If it is true that: '[t]hroughout history, institutions have been devised by human beings to create order and reduce uncertainty in exchange' (North, 1991a, p. 97), then reform of previously poorly-functioning economic institutions is only successful if uncertainty is lower post-reform than pre-reform. Our argument is that poorly-functioning institutions create excess uncertainty which a successful institutional reform will reduce.²

Limited attention has been paid to using uncertainty as a metric of economic institutional reform success because measuring uncertainty is problematic. The various definitions of uncertainty employed in a number of studies give a sense of why measuring uncertainty is difficult: uncertainty has been described as 'the condition wherein one cannot ascertain the probability of an event' (North, 1991a, p. 106), reflecting nonergodic processes (Davidson, 1991), or defined as the unforecastable part of volatility (Jurado et al., 2015). Studies of institutions and reforms have therefore tended to focus on volatility (for example, Bolen & Williamson, 2019),³ used small-scale surveys (Borner et al., 1995) or focused on one narrow aspect (such as inflation uncertainty and inflation targeting/central bank independence; e.g. Boero et al., 2008, Lawton & Gallagher, 2020.)

Fortunately, developments in recent years have meant quantifying uncertainty has improved. A renewed interest in studying uncertainty has been aided by a proliferation of data (in numerical and textual forms), along with advances in computing power and statistical methods.⁴

Armed with these new methods to measure uncertainty, we study our research question: Did the New Zealand economic reforms, which broadly covered the period 1984 to 1995, reduce uncertainty from institutional sources? The New Zealand case is interesting as it shares broad similarities with the market-oriented economic reforms in the final quarter of the 20th century in all OECD countries. In saying this, New Zealand's reforms have been called "one of the most notable episodes of liberalisation history has to offer" (Henderson, 1995, p. 66). Kelsey (1997, p. 85) notes New Zealand's reforms was centred on five areas: liberalisation of domestic markets and trade, reduction of the role and scope of the state, price stability being the objective of monetary policy, labour market deregulation and fiscal restraint.

The reforms were (and remain) controversial. In part, this reflects the conflicting messages from the conventional metrics used to evaluate institutional reform success. A highly cited article by Evans et al. (1996) contends that the reforms

¹An example of such a study in the specific episode we are studying is Evans et al. (1996)

²Successful institutional reform will not necessarily reduce uncertainty to near-zero. This is because a well-functioning economy, with well-functioning institutions, requires some uncertainty to ensure that entrepreneurial and creative destruction forces operate.

³As Jurado et al. (2015, p. 1178) put it, it matters "...not whether particular economic indicators have become more or less variable or disperse *per se*, but rather whether the economy has become more or less *predictable*; that is, less or more uncertain" [original emphasis].

⁴Bloom (2014), Castelnuevo et al. (2017), Ferrara et al. (2018), Cascaldi-Garcia et al. (2020) all provide useful surveys on the recent research on uncertainty (including its measurement).

"have markedly improved New Zealand's economic prospects and represent a radical break from New Zealand's past policies of heavy regulation and import protection, and the accompanying, by OECD standards, relatively large fiscal deficits and high rates of inflation" (p. 1894). Silverstone et al. (1996) also conclude the reforms were a success: "New Zealand's economic reform process may still rank as one of the more successful by world standards, with the potential to improve economic well-being compared to the outcomes from an unreformed economy" (p. 23); their conclusion is based, in part, on rising sectorial productivity and falling unemployment.

Not all authors have been so glowing. Dalziel (2002, p.34) argues that pre-reform is not the relevant counterfactual. He argues a better counterfactual is the more moderate reform that took place in other countries. Dalziel (2002) chooses Australia as his comparator and concludes: 'that New Zealand sacrificed a large volume of real per capita gross domestic product after 1987' (p. 38).⁵

Although there are papers that have measured uncertainty in New Zealand via different methods (Goodson, 1995; Greig et al., 2018; Kamber et al., 2016; Tran et al., 2019, Ballingall et al., 2020), none have looked at if the reforms impacted on the level of uncertainty.

This paper offers two key contributions to the literature. The first contribution is providing an empirical framework for, one, isolating the influence of institutional reform on uncertainty, and, two, assessing if uncertainty is lower post-reform, relative to pre-reform. Secondly, we show that New Zealand's reforms were successful when assessed on the criteria of reducing uncertainty from institutions (henceforth 'institutional uncertainty').

The remainder of this paper is structured as follows. In section 2.2 we briefly discuss New Zealand's institutions pre-reform and how they were changed during the reform. Sections 2.3 and 3.3 presents our methodology and results respectively. Section 5.6 outlines our conclusions; our main one being that New Zealand's reforms lowered institutionally-sourced uncertainty.

2.2 The New Zealand economy and its reform

The New Zealand Economy prior to the reforms

The depression and the world wars resulted in an institutional framework in New Zealand that focused on state-facilitated full employment (Dalziel & Lattimore, 2001, McAloon, 2013). The post-war global economy expansion until 1973 meant New Zealand enjoyed strong economic growth post-war (with the exception of a recession resulting from a large decline in wool prices in 1967) and low employment. However by the 1970s, economic institutions were problematic. Carroll (2012, p.9) notes in the face of a declining terms of trade 'the institutional wage, price and monetary policy settings made it difficult to maintain macroeconomic stability in the 1970s.' McAloon (2013, p. 172) notes '[t]he institutions of economic management were, it seems, inadequate to shape a new consensus around an economic transition'. The result was a declining economic performance relative to other developed countries, strong inflationary pressures and large fiscal and balance of payments deficits.

Part of the issue with New Zealand's institutions in the 1970s and beyond was they were generating what we term institutional uncertainty. This is, the situation

⁵In terms of other studies: Easton (1997) and Bayliss (1994) agreed with the microeconomic ideas (with reservation) and disagreed with the macroeconomic ideas underpinning the reforms; Hazledine (1998) and Kelsey (1997) are critical.

where unclear, ill-conceived or inconsistently applied laws, conventions and rules (and their enforcement) governing the activities in the economy result both in erratic and unpredictable changes in policy but also erratic and unpredictable changes in how key prices and quantities are determined.

Studies (e.g. Baker et al., 2016) have found that policy uncertainty can lead to detrimental outcomes. Just as Acemoglu et al. (2003) argue that poor policies resulting in heightened volatility are really symptoms of deeper institutional problems, we argue that detrimental outcomes owing to policy uncertainty are really the capturing the proximate effect of poor institutions. Erratic and unpredictable changes in policy arise when the institutional constraints on policy-makers are weak and result in an increase in the range of possible outcomes, which in turn, increases uncertainty.

This certainly was the New Zealand case prior to reform. Monetary and fiscal policy had changing, and sometimes, conflicting goals. Monetary policy was, in the words of Evans et al. (1996, pg. 1864), "directed towards whatever short-term problems was uppermost of the government's agenda (including reelection)" as the relevant institution—the Reserve Bank Act—had multiple goals; a lack of an institutional constraint meant fiscal policy targeted growth, unemployment, solvency and inflation at various points.

The key prices in the economy were also subject to uncertainty reflecting poorly-functioning institutions. Periodic Ministerial intervention, followed by periods of free bargaining, in the labour market added considerable uncertainty about wage rates (and potential labour availability owing to disputes). A fixed exchange rate, coupled with interest rate controls, meant firms faced uncertainty about their input or export prices (or both) owing to devaluations of unpredictable magnitude and timing (Quigley, 1992). We provide more supporting detail on how New Zealand's poorly-functioning institutions prior to reform impacted policy and prices in Appendix 1.

The reforms

Between 1984 and the mid-1990s, New Zealand embarked on significant and multifaceted reforms of its institutions. Figure 2.1 below, adapted from Silverstone et al. (1996) and Stillman et al. (2010), shows the phasing of the reforms across the different areas, and includes some key events.

The reforms are generally dated as starting with the election of the then new Labour government in July 1984.⁶ The reform could be characterised as having three distinct periods. Evans et al. (1996, p. 1856) notes 'the pace of the reform was uneven, being extremely rapid during the first two and a half years, in some areas, particularly in the financial sector and with respect to export subsidies and taxes'. The reform process slowed between early 1988 and October 1990 reflecting internal disagreement in the ruling Labour party. The pace quickened again from late 1990 as the newly-elected National government announced and enacted major changes to the welfare system (large cuts to benefit entitlements) and changes to the labour market.

New Zealand's reforms were focused on changing formal institutions and their enforcement. Evans et al. (1996, p. 1862) notes the reforms 'sought to enhance policy credibility and reduce the risks of policy reversals by setting and achieving targets...and enhance market constraints on government through deregulation and greater transparency'. That is, the reforms sought to reduce erratic and unpredictable changes

⁶Although relatively small in relation to what happened subsequently, prior to 1984 some reform had already occurred (Bayliss, 1994).

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994
Capital markets													
Financial sector		5	7										
Industrial regulation	1	3											
International trade	2			10									
Monetary policy			6				17						
Tax reform		4		9	14	15							
Corporatisation				8	11					22,23			
Privatisation					12						25,26		
Public expenditure/ public sector management						16	18						
Labour market					13				19				
Resource use									21				
Social services									20	24			

- 1 Phase out of import licensing requirements
- 2 Signing of the Closer Economic Relations trade agreement with Australia
- 3 Major agricultural reform (including abolition of supplementary minimum prices for farming and terminating various producer boards)
- 4 Phasing out of export performance tax incentives
- 5 Deregulation of foreign exchange trading, removal of controls on outward investment and borrowing and lifting of interest rate controls.
- 6 Free float of the exchange rate
- 7 End of formal financial controls (reserve ratio requirements, sector lending priorities)
- 8 State-Owned Enterprises Act led to corporatisation and restructuring of electricity generation and transmission and the introduction of user pays principles for remaining state trading activity
- 9 Introduction of a broad-based consumption (Goods and Services) tax
- 10 Start of reduction of import tariffs from an average of 28% to an average of 5%
- 11 Corporatisation of 24 state-owned enterprises (in transport, finance, tourism, forestry, broadcasting, utilities, and service industries)
- 12 Full or partial privatisation of many SOEs
- 13 Some contestability in union coverage under Labour Relations Act
- 14 Removal of tax concessions for savings
- 15 Flattening and lowering of personal income tax rate
- 16 Reform of core government departments on corporate lines through the State Sector Act, with separation of policy, provision, and funding
- 17 Independence of Reserve Bank formalised (monetary policy devoted to achieving price stability)
- 18 Public sector management reform through Public Finance Act and the redesign of government accounts on a more commercial basis with accrual accounting and output based monitoring systems
- 19 Introduction of the Employment Contracts Act which decentralised labour bargaining and decreased the role for unions.
- 20 Large cuts to spending on education, health, social welfare and superannuation.
- 21 Resource Management Act to govern more liberal planning and environmental legislation
- 22 Corporatisation of government research bodies (Crown Research Institutes)
- 23 Quasi corporatisation and fee paying for tertiary education institutions
- 24 Separation of funding from provision of state health services, establishment of Crown Health Enterprises and private sector deregulation
- 25 Corporatisation, privatisation and deregulation of gas and electricity distribution and introduction of competition in electricity generation
- 26 Privatisation of New Zealand Rail

FIGURE 2.1: The sequence of reform in New Zealand and some key events

in policy by providing institutional constraints (and providing an enforcement mechanism for these constraints). For example, the Reserve Bank Act 1989, and the Public Finance Act 1989 and the Fiscal Responsibility Act 1994, provided institutional constraints on the conduct of monetary and fiscal policy respectively. Monetary policy was to focus on low inflation, fiscal policy on ensuring prudent government debt levels and predictable and stable taxation rates (Barker et al., 2008). Finally key prices, such as wages and the exchange rate, were to be determined by the market.

2.3 Methodology

In this section we discuss three aspects of our method. The first aspect is *measuring* uncertainty (or more correctly *proxying* uncertainty). The second aspect of our method is isolating the component of uncertainty owing to institutional sources. The final aspect of our method is how to determine whether or not uncertainty is lower post-reform (relative to the period pre-reform).

2.3.1 Proxying uncertainty

Using firm-level survey data

We define uncertainty as North (1991a, p. 106) does: ‘the condition wherein one cannot ascertain the probability of an event’. It follows that increased uncertainty is the condition where the range increases of possible outcomes with unknown, but

non-negligible, probabilities. A wide range of proxies has been proposed in the literature.⁷ We briefly outline the four uncertainty proxies we use below. Our decision to use these as our proxies (compared to other proxies in the literature) reflects their relative conceptual strength and the availability of data for New Zealand over a sufficient number of years pre- and post-reform to construct them.⁸ We use a combination of four uncertainty proxies as our final uncertainty measure because each individual proxy has relative strengths and weaknesses. Therefore using a combined measure means conceptual weaknesses with one proxy are less significant. All uncertainty measures/ proxies used in this paper are normalised to have a mean of zero and a standard deviation of one.

The first three proxies are constructed using firm-level survey data. As Binge and Boshoff (2020, p. 3) note: ‘survey-based measures have the advantage that they are derived from opinions of key economic agents, as opposed to outside observers (e.g. professional forecasters) or investors on financial markets’. Within the class of survey-based measures there are two categories: dispersion-based and those based on expectation errors. We will construct both types. Our dispersion-based proxy is based on the work of Girardi and Reuter (2016), the two expectation-error-based proxies are based on Bachmann et al. (2013) and Arslan et al. (2015).

The Girardi and Reuter (2016) dispersion-based proxy

For each economic concept, c , under consideration (e.g. profits, costs) in a given forward-looking question, Girardi and Reuter (2016), using data from the Euro Joint Harmonised EU Programme of Business and Consumer Surveys, construct a dispersion index:

$$DISPFW_{c,t} = (fu_{c,t} + fd_{c,t} + (fu_{c,t} + fd_{c,t})^2)^{0.5} \quad (2.1)$$

where $fu_{c,t}$ ($fd_{c,t}$) is the fraction of firms reporting they expect an ‘increase’ (‘decrease’) on the given survey question j about economic concept c .

The time-series of the measure $DISPFW_{c,t}$ is then standardised to have a zero mean and a unit standard deviation.⁹

For each sector i , each question j relates to a different economic concept c , and in each quarter t , we create the forward-looking index described above ($DISPFW_{ijt}$).¹⁰

⁷Broadly speaking the proxies of uncertainty can be aggregated into three groups. The first group are those that measure uncertainty by equating it with disagreement either between survey respondents or between a forecast and the actual outcome (e.g. Girardi & Reuter, 2016; Arslan et al., 2015; Bachmann et al., 2013; Caggiano et al., 2022; Scotti, 2016). The second group of measures are text-based and assess perceptions of uncertainty by counting the proportion of specific words in a set of texts (e.g. Baker et al., 2016; Castelnuovo & Tran, 2017). The final group are variance or volatility type measures (e.g. Jurado et al., 2015; Ludvigson et al., 2021; Mumtaz & Theodoridis, 2017).

⁸Ballingall et al. (2020) find newspapers are not digitally available with sufficient quality before 1995 to construct a text-based uncertainty index. Unfortunately, this precludes the construction of a policy uncertainty index in the style of Baker et al. (2016). This is unfortunate because, as we noted in section 2.2, there is a conceptual link from institutions to policy uncertainty.

⁹Girardi and Reuter (2016) argue that survey-based dispersion measures capture three concepts: heterogeneity reflecting different firm circumstances, disagreement owing to different firm information sets and uncertainty. They propose a method for removing the effect of firm heterogeneity, but this requires assuming that economic conditions remain (broadly) stable between consecutive surveys. Unfortunately this assumption is not valid in our context. The pre-reform period was a time of instability in economic conditions in New Zealand. For example, labour relations were a source of instability in the pre-reform, as were periodic policy reversals and the changing targets of policy (see section 2.2).

¹⁰We impose a requirement of a minimum of 30 sector-specific responses for each question; if that threshold is not met, we interpolate the index for that quarter using the spline interpolation procedure in the imputeTS R package Moritz and Bartz-Beielstein (2017).

In our dataset, discussed in more detail in section 2.3.1, there are five sectors: financial services, other (non-financial) services, builders, manufacturers and merchants (retail and wholesale); each sector has J forward-looking questions.¹¹ In a second step, we create an overall sector measure for each sector i , $DISPFW.it$, by taking the first principal component across the J indices for each sector.

The two expectation errors-based proxies

Arslan et al. (2015), Bachmann et al. (2013) and Binge and Boshoff (2020) use a slightly different transformation of the directional survey data to calculate uncertainty. These papers take advantage of a forward looking question in time $t - 1$ and an *ex post* assessment in t about a given economic concept c . The argument is that expectation errors are more likely when uncertainty is higher.

These papers transform differences in actual and forecast outcomes into numerical data; although the precise transformation differs between papers, Table 2.1 illustrates how such a transformation can be made.¹² Where the experienced and the expected activity agree (the diagonal elements of Table 2.1) then a value of zero is assigned. If the experienced activity in time t was higher (lower) than expected activity in $t-1$, then we assign a weight, $w_{i,t}$, of -0.5 or -1 (0.5 or 1) depending on the extent of the disagreement. For example if, in the Q3 survey, a firm expects an increase in profits in Q4 but in the Q4 survey the firm reports a decrease in profits, a weight of $+1$ is assigned.

TABLE 2.1: Weights from Arslan et al. (2015)

	$Decrease_{c,t}$	$Nochange_{c,t}$	$Increase_{c,t}$
$ExpectedDecrease_{c,t-1}$	0	-0.5	-1
$ExpectedNochange_{c,t-1}$	0.5	0	-0.5
$ExpectedIncrease_{c,t-1}$	1	0.5	0

Using these weights, it is possible to calculate the following uncertainty proxy:

$$IDIO_t = \frac{\sum_{i=1}^N (w_{i,t} - \bar{W}_t)^2}{N} \quad (2.2)$$

where $\bar{W}_t$ is average ‘uncertainty’ across all respondents:

$$\bar{W}_t = \frac{\sum_{i=1}^N (w_{i,t})}{N} \quad (2.3)$$

where N is the number of firms.

Arslan et al. (2015, p. 644) describes the measure in equation (2.2) as an ‘idiosyncratic uncertainty measure because it measures how individual firms depart from the overall mean on expectation errors’. Arslan et al. (2015) also propose a formula based on the average error: $(\bar{W}_t)^2$. They call this aggregate uncertainty. We create both of these indices.

¹¹The number of forward-looking questions, J , differs between sectors; we discuss this in the Appendix 2.

¹²This is the Arslan et al. (2015) setup. Bachmann et al. (2013) use different weights as they have to adjust for the fact the backwards-looking question in the survey they use only reports on the last month, whereas the forward-looking question asks about the next three months; this is not an issue in our case. Binge and Boshoff (2020) use the above weights scaled by two.

The two expectations-based indices (the aggregate uncertainty and the idiosyncratic uncertainty indices) are created for each forward-looking question, for each sector and for each quarter. To calculate expectation errors, each forward-looking question must have a corresponding backward looking question; this results in a smaller pool of available questions than the dispersion-based measure discussed previously (see Appendix 2). For each sector, two measures (one for aggregate uncertainty and the one for idiosyncratic uncertainty) are then created by taking the first principal component across the relevant individual question indices for each sector.

The Quarterly Survey of Business Opinion

The three uncertainty proxies are constructed using unit record firm-level survey data from the Quarterly Survey of Business Opinion (the 'QSBO'). Since 1961, the QSBO has continuously surveyed New Zealand firms, beginning with manufacturers. Firms from various sectors were added to the survey at different points in time. More on the QSBO, and its history, are available in Appendix 2.

The QSBO uses stratified sampling based on employee groups; however all firms with fewer than six employees are excluded and all firms with more than 200 employees are sampled (Buckle & Silverstone, 2011).¹³ In creating our indices, we weight firm responses by employee size; the weights were provided by NZIER. Weighting requires that there is sufficient sample size in each employee group. Our analysis suggests a sufficient sample size is reached in each employee group in 1975, therefore we start constructing our indices from then (plus the retail sector only started being included in 1974).¹⁴ We combine our sector-specific uncertainty proxies into one overall economy-wide index. We start by an overall sector-specific index for each sector. To do this, we take an arithmetic average of the three proxies (dispersion-based and the two expectations-based ones) for each sector.¹⁵ The next step is to combine the five sector-specific indices into an economy-wide index. To achieve this, we weight sector-specific indices by the share of real GDP of the sector corresponding to the March year that quarter t falls in.¹⁶ We plot this combined economy-wide measure in section 2.3.3. Because this index is constructed firm-level data, our paper should be thought of as studying uncertainty from a firm's point of view.

2.3.2 Stochastic volatility-based measure

As a data source, the QSBO is very useful but it does exclude firms in the agriculture, government and utilities sectors. Given the importance of agriculture to the New Zealand economy, the omission of such respondents is significant. That said, the inclusion of respondents from the primary manufacturing sector means there is a chance uncertainty from agriculture sources will be captured (to some degree, at least).

¹³There are six employee groups: 1 to 20, 21 to 50, 51 to 100, 101 to 200, 201 to 500 and 500 and over.

¹⁴We weight to be consistent with some of the literature (e.g. Binge & Boshoff, 2020) and also the statistics generally reported from the survey such as the headline business confidence number. It makes little difference however at a sector-level, the correlations between weighted and unweighted indices are between 0.88 and 0.97.

¹⁵Taking a principal component makes little difference.

¹⁶The sectorial GDP data come from Statistics New Zealand's Infoshare (<http://archive.stats.govt.nz/infoshare/>; accessed 20 December 2019).

Further, one of our uncertainty indices—the dispersion-based measure—is really a ‘lack of consensus’ or disagreement measure. An on-going debate in the literature has been if you can equate ‘lack of consensus’ with high uncertainty.¹⁷

To deal with these difficulties, we construct another uncertainty proxy based on a totally different data set and methodology. Berger et al. (2016) use a dynamic factor model with stochastic volatility to estimate global and country-specific output uncertainty for a set of OECD countries. We update their model for our sample period; more information on the updating and the model are available in Appendix 3.

Figure 2.2 shows the New Zealand-specific (‘NZL’) and common OECD uncertainty (‘Common’) proxies we created using the Berger et al. (2016) approach; both are normalised to mean zero and standard deviation one. The major spike in the OECD common uncertainty proxy occurs around the global financial crisis, with lesser spikes around the two oil shocks and the stock market crash in 1987. Interestingly, the Asian Financial Crisis does not appear to register. The New Zealand-specific uncertainty proxy rose prior to 1984; this could reflect the uncertainty associated with the wage/prize freeze, the government’s financial position and the foreign exchange situation (or a combination of all three). The proxy was also highly elevated over the period 1982 to 1987; the proxy then falls, but remains elevated relative to other periods, over the period 1988 to 1995. This is consistent with the narrative that the first part of the reform was more intense than the second part (see discussion in Section 2.2). Interestingly, the major global events cited above (such as the global financial crisis) have no New Zealand-specific effect; put another way these events impacted on New Zealand and this effect was similar to other countries: there was no New Zealand idiosyncratic effect.

Figure 2.3 plots the Berger et al. (2016) (‘Berger’) proxy for New Zealand against our combined economy-wide QSBO measure (‘QSBO’) which we discussed in section 2.3.1. The proxy of Berger et al. (2016) is smoother than the combined QSBO proxy and peaks at a higher level over the reform period. The combined economy-wide QSBO measure spikes around the early 1990s recession, the Asian crisis of 1997/98 and the Global Financial Crisis.

2.3.3 The final proxy of New Zealand-specific uncertainty

We feel both proxies have information content. Our final, preferred measure of uncertainty is therefore the arithmetic mean of the two proxies (plotted in Figure 2.3 as ‘Combined’). Papers studying uncertainty generally use visual inspection to validate their uncertainty measures. Visual validation of uncertainty measures examines how well spikes in measured uncertainty correlate with events hypothesised to result in/ or be the result of heightened uncertainty. In Figure 2.3, red-shaded areas represent recessions (as identified by Hall & McDermott, 2016) and the dotted lines, with an associated code, represent other significant events associated with uncertainty. The event the code represents is set out at the bottom of Figure 2.3. In general, the combined measure spikes during recessions and around the significant events identified; further it is evaluated during the reform period (particularly the early part).

¹⁷For example, Zarnowitz and Lambros (1987) reports a positive association between disagreement and uncertainty; Boero et al. (2008) and Abel et al. (2016) report weak correlations.

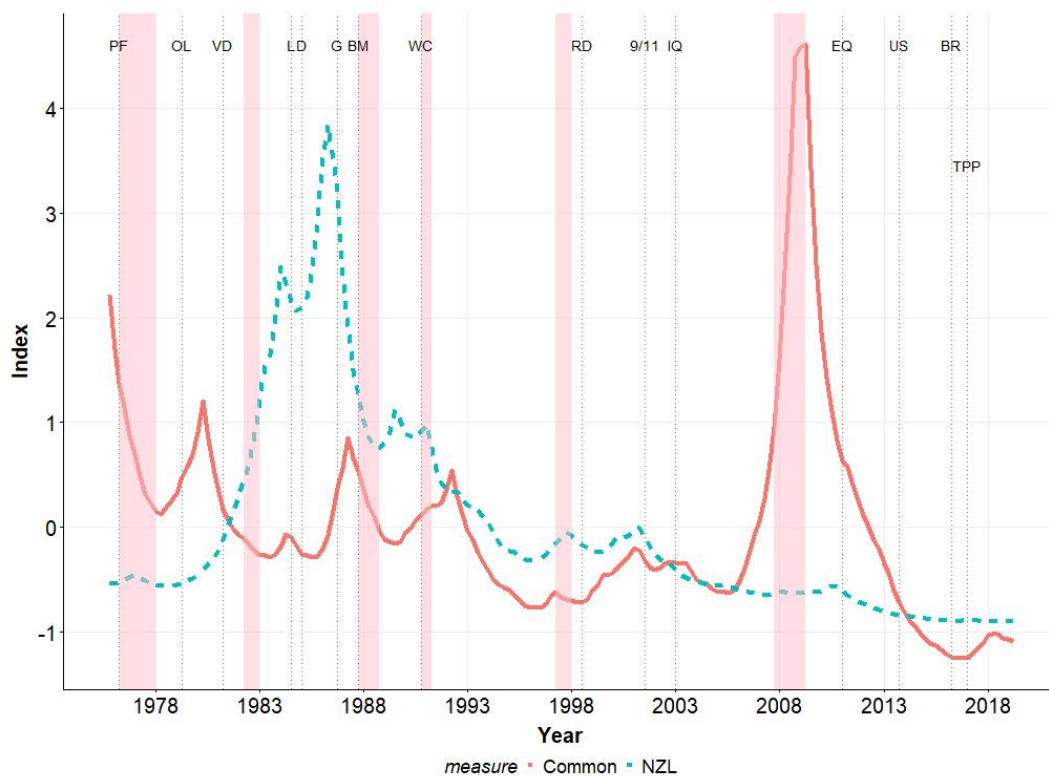


FIGURE 2.2: Updated OECD common and New Zealand-specific measures using the Berger et al. (2016) methodology

Pink shaded areas are recessions from Hall and McDermott (2016); see figure 2.3 for the code lookup table

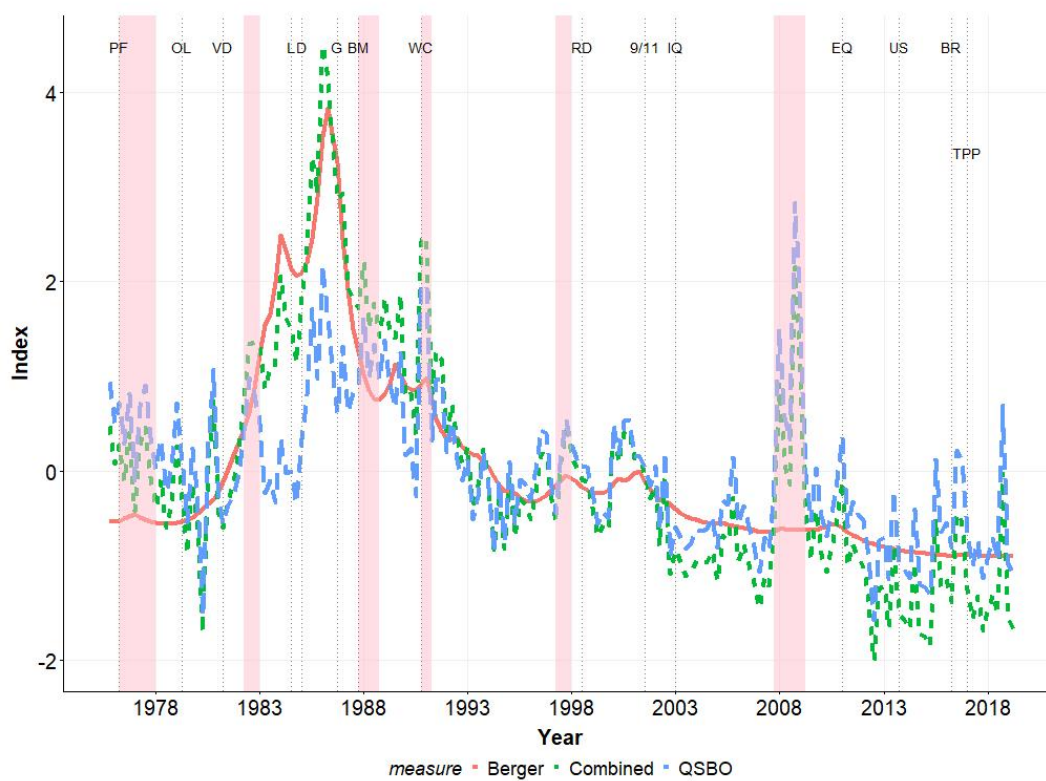
2.3.4 Isolating uncertainty from domestic institutional sources

Having constructed our final proxy of New Zealand-specific uncertainty, we now try to isolate uncertainty that comes from domestic institutional sources. To do this we need to control for other channels that impact on uncertainty such as the state of the business cycle (with uncertainty rising during recessions). Further a small open economy, might ‘import’ uncertainty from foreign sources.

We use two proxies of foreign uncertainty: the US financial uncertainty proxy of Ludvigson et al. (2021) and the OCED common output uncertainty proxy of Berger et al. (2016) discussed above (see Figure 2.2). US financial uncertainty will affect the New Zealand economy via the cost (and perhaps the availability) of capital, as well as through the exchange rate.¹⁸ Output uncertainty will affect the New Zealand economy through demand for New Zealand’s exports. Given New Zealand recessions have been triggered, in part, by events overseas (Reddell & Sleeman, 2008), we also include a measure of the OECD output gap.¹⁹ We also include a domestic (New Zealand) output gap; this was created by applying the technique outlined by Kamber et al. (2018) to the real GDP series of Hall and McDermott (2011) (updated to 2018Q2 by us).

¹⁸In times of uncertainty, money tends to flow toward the USD (a ‘safe haven’) and away from the New Zealand dollar; see Kamber et al. (2016).

¹⁹We create this by using the OECD Industrial Production series to construct an output gap using the technique outlined in Kamber et al. (2018); we made use of the R code provided by James Morley <https://sites.google.com/site/jamescmorley/research/code>.



Date	Event	Code
1976Q2	Start of 12 month price freeze	PF
1979Q2	2nd oil shock	OL
1981Q2	Peak of Volcker deflation	VD
1984Q3	Election of Labour government	L
1985Q1	NZD floated	DF
1986Q4	GST introduced	G
1987Q4	Black Monday sharemarket crash	BM
1990Q4	Announcement of welfare cuts	WC
1998Q4	LTCM crisis/Russian default	RD
2001Q3	Terror attacks on the US	9/11
2003Q1	Iraq invaded	IQ
2011Q2	Christchurch Earthquake	EQ
2013Q2	Start of 2013 debt ceiling crisis	US
2016Q2	Brexit vote	BR
2017Q1	TPP withdrawal by the US	TPP

FIGURE 2.3: New Zealand specific uncertainty measures

We estimate a small Structural Vector AutoRegression (SVAR) to control for endogeneity between uncertainty and output. We estimate two versions of the Structural VAR model via Bayesian methods. Both versions have four lags and are estimated over the sample period 1975Q4 to 2018Q4; more information on the estimation specifics of both models is available in Appendix 4.²⁰

²⁰The choice of lag length is less critical with Bayesian models than under the classical alternative. This is because the Minnesota prior (which we use) imposes the prior standard deviation shrinks by a factor $1/\text{Lag number}$ —i.e. we assume we are increasing confident that the lag coefficient is zero. We set four lags as our maximum lag length just in case there is any unaccounted for seasonality in the data.

The first model, subsequently called the time-invariant SVAR (or TI-SVAR) for short, treats parameters as time-invariant.

We begin with a reduced-form VAR of the form:

$$\begin{bmatrix} Y_t^F \\ Y_t^{NZ} \end{bmatrix} = \begin{bmatrix} B(L)_{F,F} & 0 \\ B(L)_{NZ,F} & B(L)_{NZ,NZ} \end{bmatrix} \begin{bmatrix} Y_t^F \\ Y_t^{NZ} \end{bmatrix} + u_t \quad (2.4)$$

where Y_t^F is the set of foreign variables: foreign financial uncertainty, foreign output uncertainty and the foreign output gap. Y_t^{NZ} is the set of New Zealand variables: uncertainty and the output gap. $B(L)_{NZ,F}$ is the lag operator in the block where foreign variables are the independent variables and New Zealand variables are the dependent variables and $B(L)_{F,F}$ ($B(L)_{F,F}$) is the lag operator in the block where foreign (domestic) variables are both the independent variables and dependent variable; all lag operators are of length four. Consistent with New Zealand's small open economy status, the foreign block is 'block exogenous' to the domestic block: foreign variables can affect domestic variables but not vice versa.

In equation 2.4, u_t is a vector of reduced-form errors. The structural errors are recovered from the reduced form errors by imposing Cholesky factorisation, separately, in both the foreign and the domestic blocks. The ordering to achieve identification in the foreign variable block is foreign financial uncertainty, foreign output uncertainty and the foreign output gap; we adopt this assumption (that uncertainty affects output contemporaneously, not vice-versa) as it is a common one in the literature (for example, see Bloom, 2009; Bachmann et al., 2013; Bekaert et al., 2013; Kamber et al., 2016), but it also seems plausible that given output variables are released with a lag, bad news about the economy might take a while to impact on uncertainty.²¹ The domestic block orders uncertainty first, output second. Again, this reflects the standard practice in the literature, but also the fact that the QSBO—the survey used to construct some of the proxies that a combined for our uncertainty measure—is conducted in the last month of the quarter and asks about the next three months, whereas GDP in New Zealand is released three months after the quarter has finished. It would be more plausible, therefore, to assume that GDP does not have a contemporaneous effect on uncertainty.²²

An implicit assumption in the above model—that the relationships between the economic variables remain constant over time—might be too strong. The opening up of a previously protected domestic sector to competition from foreign imports and the removal of restrictions on foreign capital means that since 1984 the impact of foreign variables could be more significant on New Zealand uncertainty than prior to 1984. To allow for this, our second model implements a time-varying version of the previous model (that also allows for heteroskedasticity); we call this model TV-SVAR for short. Owing to difficulties imposing block exogeneity with time-varying parameters, we treat the foreign variables as exogenous (what is termed an SVARX by Kilian & Lütkepohl, 2017).²³ More technical details on the time-varying model we estimate are set out in Appendix 4. The domestic structural shocks are identified by

²¹Rivolta and Trecroci (2020, p.12) notes different studies suggest different ordering for the uncertainty variables, but all suggest that uncertainty variables should be ordered before output variables. Our ordering of financial uncertainty before real/output uncertainty is consistent with Jurado et al. (2015).

²²Recursive identification of SVARs is common place but not without its critics (see Kilian & Lütkepohl, 2017 or Ludvigson et al., 2021 in the uncertainty context).

²³The difference between the SVARX set up and the 'block exogeneity' set up is in the 'block exogeneity' set up, the foreign variables are allowed to 'interact' with each other and this means shocks to these foreign variables can be identified; in the SVARX set up, the foreign variables are exogenous to the system (the system being the two domestic/New Zealand variables).

Cholesky factorisation and the ordering of variables is the same as the time-invariant model.

Both forms of the Structural VAR model discussed above allows—via the estimated structural shocks and estimated regression coefficients—for the construction of an historical decomposition. This is a key tool in our analysis. In the case of the time-invariant SVAR, an historical decomposition of New Zealand uncertainty allows us to understand how much of the historically observed movements in New Zealand uncertainty can be explained by each of the structural shocks in the model: foreign financial uncertainty, foreign output uncertainty, foreign output, New Zealand output and its own shock.²⁴

The question then becomes how does one interpret New Zealand uncertainty's own shocks? Our key assumption is that New Zealand uncertainty's own shocks are from institutional sources. Why might this hold true? Our model identifies other shocks from macroeconomic or financial sources (e.g. the state of the economy, the financial sector), leaving us with a possible interpretation that New Zealand uncertainty's 'own shocks' as being from non-macroeconomic or financial sources. Our discussion in section 2.2 indicates that institutions are the prime candidate of a non-macroeconomic or financial source of uncertainty given the events in the New Zealand economy over our sample period.

It is, however, worth considering other explanations. Being a small, open, agricultural dependent economy, climatic events and natural disasters in New Zealand could represent non-macroeconomic or financial sources of uncertainty. However, our robustness tests in Appendix 5 show that controlling for climate and natural disasters in the model makes little difference to the estimated contribution of its 'own shock' to the New Zealand uncertainty series; the impact of natural disasters is seen more on New Zealand output. We also conduct a robustness test (also reported in Appendix 5) where we control for the changing structure of the economy; specifically the idea that a compositional shift from manufacturing to services might lower uncertainty (Fernández-Villaverde & Guerrón-Quintana, 2020). Again, this made little difference to the estimated New Zealand uncertainty 'own shock' series. Finally, one could propose that technology disturbances drive New Zealand uncertainty shocks. Given New Zealand is an open, small economy we would argue these are likely to be captured by the foreign uncertainty shocks/variables, rather than the domestic uncertainty shocks.²⁵

In saying all this, it is probable that quarterly movements in the 'own shock' series are affected by factors other than institutional factors. However, as our empirical method focuses on comparing averages pre- and post-reform, it is acceptable for uncertainty's 'own shock' to be affected by omitted—non-institutional—variables, as long as the omitted variables are not systematically higher or lower post-reform

²⁴Consider an hypothetical example. In 2006Q1, New Zealand uncertainty was, say, one index point; again say, 0.1, 0.15, 0.2, 0.25 of that index value was contributed by foreign financial uncertainty, foreign output uncertainty, foreign output and New Zealand output shocks respectively; this leaves 0.7 index points of observed New Zealand uncertainty accounted for. Of the remaining 0.3, say 0.2 comes from New Zealand uncertainty's own shocks and 0.1 from the exogenous variables in the model (e.g. the constant). In the time-varying SVAR we can only decompose New Zealand uncertainty into its own shocks and the contribution from the New Zealand output gap owing to the SVARX structure. The combined contribution of the foreign variables and the constant are measured as one in the exogenous shock variable. Kilian and Lütkepohl (2017) offers a detailed exposition of historical decompositions.

²⁵We ran some further robustness tests using alternative modelling assumptions (priors, lags etc) which showed the key dynamics of our estimates of institutional uncertainty are unaffected; these are discussed in Appendix 5.

than pre-reform.²⁶

2.4 Results

2.4.1 Our estimates of institutional uncertainty

Figure 2.4 shows our estimate of institutional uncertainty from our two models: the time-invariant model (TI-SVAR) and the time-varying SVAR (TV-SVAR). As Figure 2.4 shows the model shows a strong degree of correlation (0.89) between the measures produced by the two models. Both series show spikes in institutional uncertainty in the initial period of the reform (a period that included the floating of the exchange rate, the removal of capital controls, the introduction of GST, amongst other things), in the December quarter of 1990 (a quarter which saw the announcement of large social welfare benefit cuts and new employment legalisation in what was called the 'Economic and Social Initiative Budget') and around the GFC (perhaps reflecting some uncertainty about New Zealand's response). Visually both series show institutional uncertainty was highly elevated during the reform period and that institutional uncertainty was higher in the pre-reform period, on average, than the post-reform period.

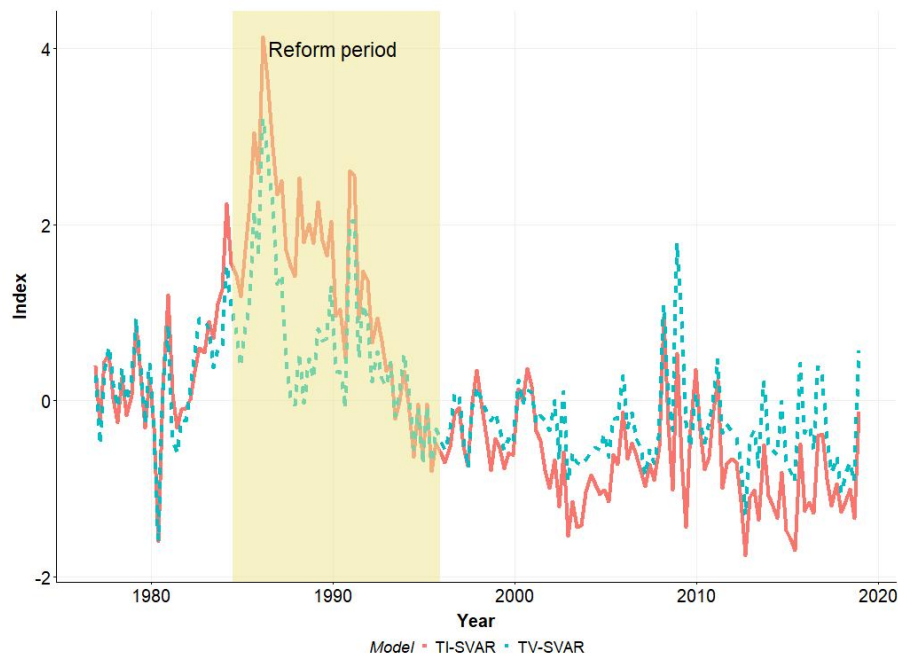


FIGURE 2.4: Historical contribution of New Zealand uncertainty's own shocks to New Zealand uncertainty

²⁶A technical issue with using the historical decomposition is that it involves an approximation error at the start of the sample owing to truncation of the moving average representation (Kilian & Lütkepohl, 2017, p. 118). As Kilian and Lütkepohl (2017, pg 118) recommends we plotted the actual uncertainty series against the estimated historical decomposition uncertainty series and find the approximation error is small.

2.4.2 Did institutional uncertainty fall post-reform?

We wish to answer the question of ‘Did institutional uncertainty fall post-reform?’ To do this we test for unknown structural breaks in the equations:

$$UNZ_{unz,t} = c \quad (2.5)$$

where $UNZ_{unz,t}$ is our time series of institutional uncertainty plotted in Figure 2.4; and

$$UNZ_{unz,t}^{RO} = c \quad (2.6)$$

where $UNZ_{unz,t}^{RO}$ is the $UNZ_{unz,t}$ variable reordered: (1977Q1 : 1984Q2; 1996Q1 : 2018Q4).

That is, the data are rearranged so the reform period is omitted: the pre-reform period is followed by the post-reform period.

The first breakpoint test in equation 2.5 allows us to test for structural breaks in institutional uncertainty as the economy transited into and out of the reform. The second breakpoint test in equation 2.6 allows us to directly test for a structural break between the pre- and post-reform periods.²⁷

TABLE 2.2: Identified breakpoints in the institutional uncertainty series

Break Point	Scaled F-statistic	5 per cent critical values
<i>Institutional uncertainty from time-invariant SVAR</i>		
Temporally-ordered/ full sample		
1983Q3	86.4	10.13
1993Q2	151.7	8.58
2001Q3	37.9	11.14
2012Q2	11.9	12.83
Reform period removed		
1996Q1	57.7	8.6
2002Q2	12.0	11.1
2012Q2	26.4	10.1
<i>Institutional uncertainty from time-varying SVAR</i>		
Temporally-ordered/ full sample		
1983Q1	21.5	10.13
1993Q2	67.81	8.58
Reform period removed		
1996Q1	21.7	8.6

Table 2.2 shows the identified breakpoints, using equations 2.5 and 2.6, for the two institutional uncertainty estimates from the respective models; the critical values are from Bai and Perron (2003). Figure 2.5 show the average (mean) of our estimates of institutional uncertainty in the periods bordered by our breakpoints.

²⁷Structural break testing for multiple, unknown structural breaks were implemented in EViews using the Bai-Perron tests of L+1 vs L sequentially determined breaks. We allow for a maximum of five breaks, test for breaks at a five per cent significance level and trim 15 per cent of the observations at the beginning and end of the sample. We also allow for heterogeneous error distributions across breaks.

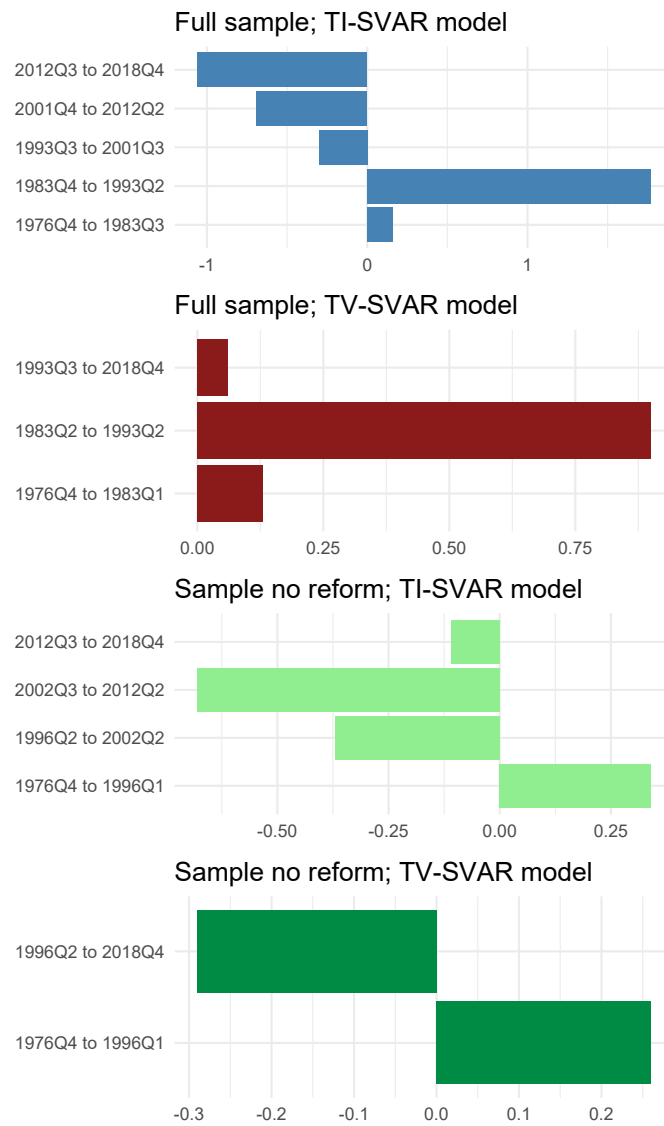


FIGURE 2.5: Mean uncertainty in periods bordered by identified breakpoints

When the full sample is used (i.e. equation 2.5 is estimated), two breakpoints are found consistently across both uncertainty series from the respective models: one in the region 1983Q1 to 1983Q3 (i.e a year or so prior to the reform); another in 1993Q2. Further, the top two graphs in Figure 2.5 show the mean of our estimates of institutional uncertainty is higher in the pre-reform period bordered by our breakpoints than in the post-reform period (and uncertainty was highest during the reform period itself). Finding 1993Q2 to be a break point is interesting as Evans et al. (1996, Figure 2) indicate the last of the reform announcements were made in 1992 and 1993.

Turning to results based on the institutional uncertainty data reordered such that the reform period is removed (this allows us to test directly if uncertainty was lower post-reform, relative to pre-reform). The results would suggest uncertainty is lower post-reform than prior to it: a structural break in 1996Q1 (i.e. the start of the post-reform period) is identified in the institutional uncertainty series from both models. Further, the mean of institutional uncertainty is lower after this break point (see Figure 2.5, bottom two graphs).²⁸

Understanding the historical drivers of uncertainty in New Zealand

One way to check how sensible our results are is to look at the other factors our models identify as significantly affecting New Zealand uncertainty (and how the relative significance of these factors has changed through time) and check this against a commonly understood historical narrative; we use an historical decomposition to facilitate this. Kilian and Lee (2014; cited in Kilian & Lütkepohl, 2017) proposes a simple way to present the information conveyed by historical decomposition: the bar chart. In their bar chart, the total change in the variable of interest between two dates is presented as one bar, with the other bars being the contribution of shocks to the other variables (as well as its own shock) to the change. This device allows the researcher to understand which shocks lead to the majority of the change in the variable of interest between the two dates. We adopt this approach. We split our sample into three-yearly groups. Figure 2.6 shows how the three-year cumulative contribution of each shock to New Zealand uncertainty has changed through time; we use the time-invariant SVAR for this analysis as it allows us to examine foreign influences on uncertainty.

The year on the y axis of Figure 2.6 represents the end of the period, so the panel on the graph labelled 1984Q2 shows the cumulative contribution of each shock to the change in New Zealand uncertainty between 1981Q3 and 1984Q2. In this period, the index level of overall New Zealand uncertainty rose 1.9 units ('TOTAL'); the main contributor was institutional uncertainty as proxied by New Zealand uncertainty's own shocks ('OWN') which grew 1.7 units over the period (the blue bar). The other possible influences: foreign financial uncertainty (red, denoted FFU), foreign output uncertainty (tan bar, denoted FOU), foreign output (green bar, denoted FYGAP) and the New Zealand output gap (purple bar, NZYGAP), all made negligible contributions.²⁹

In Figure 2.6, a number of things stand out. The large increase in institutional uncertainty immediately prior to the start of the reform, this is consistent with the

²⁸All the above inferences hold when we search for 'known' break points using a dummy variable specification; see Appendix 6.

²⁹All the different shock contributions should add to the change in overall New Zealand uncertainty. In practice they do not because the historical decomposition point estimates are the median values from the empirical distribution from the many models sampled via the Gibbs sampling algorithm; individual models add up but point estimates from the empirical distribution do not as they likely correspond to different models.

findings of Bonfiglioli and Gancia (2015) who find, in a cross-country study, heightened uncertainty increases the likelihood of countries adopting reforms. We also see, with the exception of the period around the GFC, institutional uncertainty has been a negative contributor to uncertainty growth since 1987.³⁰ There are a few periods where foreign financial uncertainty has been a positive contributor to uncertainty in New Zealand: the period 1996Q3 to 1999Q2 (the Asian Crisis) and the period 2005Q3 to 2008Q2 (the latter part of this period included the first part of the GFC: 2007Q3 to 2008Q2). While the second oil shock and the Volcker deflation appeared to impact New Zealand uncertainty more through the foreign output gap—New Zealand was very closed to overseas capital during this period (meaning foreign financial uncertainty was less important), so uncertainty was felt more through uncertainty about demand for New Zealand's goods.

2.4.3 Testing the robustness of our results by explicitly including a measure of institutions

Sims (1998) makes the point that equally valid SVAR specifications can imply quite different shock series (and therefore historical decomposition). Although we have undertaken a number of robustness tests (including by adding other variables), it may be that our identified 'own' uncertainty shocks and therefore our measure of institutional uncertainty is dependent on the specification. One idea to test our key conclusion—that the New Zealand reforms lowered institutional uncertainty—is to include a measure of institutional status in the model. So we re-estimate our time-invariant SVAR with the same variables as the baseline specification outlined in section 2.3.4 but with a measure of institutional status added.

Our revised ordering assumes that changes to New Zealand's institutions affect New Zealand's uncertainty contemporaneously but, owing to the slow pace of changing institutions, it takes time for uncertainty in New Zealand to affect institutions.

The measure of institutional status is constructed using variables from Prati et al. (2013). The measure is plotted in Figure 2.7; more information on the construction of the variable is available in Appendix 7.³¹ The index reflects the tenor of our discussion of the reform in section 2.2: the initial period of the reform was rapid but then the pace slowed and by 1995 the reform was more or less complete. The measure is really measuring market liberalisation—one aspect of the institutional reform, but an important one. Easton (2020) characterises the reform as a move towards 'more market'. Further, a measure of the liberalisation of the New Zealand economy is likely to be strongly correlated with a hypothetical overall measure of institutional status given all the institutional changes that occurred over a confined period in the mid-1980s to the mid-1990s.³²

³⁰A possible explanation for why institutional uncertainty rose around the GFC is that firms were initially uncertain about how government would respond.

³¹As the Prati et al. (2013) series is only available to 2005 we extrapolate the data out to 2018 based on the assumption that the degree of liberalisation is similar over the period 2006 to 2018 as it is in 2005. Further the original data is annual, so we interpolate a quarterly series using the Denton-Cholette method via R's Tempdisagg package Sax and Steiner (2013).

³²As we stated in the introduction, Kelsey (1997, p. 85) notes New Zealand's structural adjustment programme centred on five areas. The indicator we use reflects the first two of these areas: liberalisation of domestic markets and trade, and reduction of the role and scope of the state. Given the announcements and implementation of changes in the other areas happened slightly later it may be that the indicator we use underestimates the speed of the institutional reform in the latter period.

We calculate the impulse responses as per the local projections method of Jordà (2005). The method requires estimating a regression for each horizon, $h = 0, 1, 2, \dots$, for each variable:

$$y_{t+h} = \alpha_h + \beta_h \text{shock}_t + \psi(L)z_{t-1} + \epsilon_{t+h} \quad (2.7)$$

where y is the variable of interest, *shock* is the identified shock series from the aforementioned recursive SVAR. Below we report the impulse responses for two shocks: a shock to institutional status and a New Zealand uncertainty. z is a vector of control variables which is all the variables in the aforementioned recursive SVAR plus an estimate of (log) potential GDP. $\psi(L)$ is the lag operator.

We use the local projection method, rather than the standard delta method, because the confidence intervals ‘remain valid even if the data exhibits unit roots, and even at horizons that are allowed to grow with sample size’ (Montiel Olea & Plagborg-Møller, 2021, p. 2). Both the institutional status variable and (log) potential output contain unit roots. Selected impulse responses are plotted below (Figure 2.8). We see that initially a ‘positive’ institutional shock (i.e. a move towards market liberalisation) increases uncertainty, consistent with the idea that firms do not like change and are unsure about how the new regime will work. Further many of the reforms exposed previously protected firms to foreign competition, meaning, initially, uncertainty increased as firms adjusted to this new situation.³³ However once firms adjusted, uncertainty eventually fell. The interaction between uncertainty and institutions appears to run both ways, uncertainty shocks also appear to bring about institutional change; this is consistent with our findings in section 2.4.2. We also see institutional change leads to an increase in the output gap and potential output.

A one unit uncertainty shock lowers the output gap by 0.4 percentage point; this is slightly higher than Greig et al. (2018) and Tran et al. (2019) who find a peak impact of between -0.25 and -0.35 percentage points on the output gap after three to four quarters. A one unit shock to uncertainty lowers the level of potential output by one per cent; this is consistent with uncertainty delaying investment which leads to a lower capital stock.

We need to note some caution with these results. Because our institutional status variables suffers from measurement error, so will our estimate of shocks to institutional status. This will lead to attenuation bias in our estimated impulse responses. One solution, as set out in Ramey and Zubairy (2018), is instrumental variable estimation of the local projection model. Our attempts to do this, with some caveats around the analysis, are reported in Appendix 8.

2.5 Conclusion

Douglass North argued that institutions are designed to reduce uncertainty. The corollary of this is the transition from poorly-functioning to well-functioning institutions will be marked by a reduction in uncertainty. The change in the level of uncertainty post-reform relative to pre-reform is, therefore, an important metric for judging the success of reform. However, isolating how uncertainty has changed

³³Heightened uncertainty immediately after the institutional change is also consistent with the description of the implementation of New Zealand’s reform process by Kelsey (1997). She talks of ‘the changes being implemented at a blistering pace’, with ‘[m]uch of the legislation...made on the hoof...with details added part-way through the parliamentary process’ (p. 42-43).

post-reform relative to pre-reform is difficult owing to, amongst other things, measuring institutional change and uncertainty and isolating the movements in uncertainty owing to changes in the institutional settings and movements owing to other reasons. In this paper we offer a preliminary method for addressing some of these issues.

We applied our method to the New Zealand institutional reforms from the mid-1980s to the mid-1990s; we assess the reforms were successful in reducing uncertainty from institutional sources (although we are silent about whether more or less radical reform would have been more successful). Consistent with earlier literature, we find that heightened uncertainty pre-reform may have been the catalyst for reform itself.

We show that besides domestic institutional sources, changes to foreign demand and foreign uncertainty cause uncertainty in New Zealand periodically; this is likely to be the case for most small open economies. Given small open economies have no control over events in foreign countries, the onus is on governments and the citizens in these economies to ensure their institutions are functioning as effectively as they can and not generating uncertainty unnecessarily.

Earlier, we described our paper as offering a preliminary method; there is no doubt our method can be refined. A few immediate suggestions are as follows. The models in this paper are identified via recursive identification, which is popular in the literature owing to its ease. Alternative identification methods, such as sign restrictions and instrumental/proxy variables, have been developed in the literature and future papers could use these methods to test how robust our conclusions are. Further, Berger et al. (2020) notes the tight relationship between news and uncertainty shocks. Further research might examine if some of the reduction in uncertainty we attribute to institutional change might actually be owing to positive news shocks about the future of the economy.

2.6 Appendices

Appendix 1: Poorly-functioning institutions, uncertainty and New Zealand prior to the 1984 reform

In our article we note we see 'institutional uncertainty as the situation where unclear, ill-conceived or inconsistently applied laws, conventions and rules (and their enforcement) govern... the activities in the economy'; with the result being: 'erratic and unpredictable changes in policy but also erratic and unpredictable changes in how key prices and quantities are determined'.

This appendix provides more information on the erratic and unpredictable characterised the conduct of policy in New Zealand prior to reform. As a summary it is hard to go past this quote from McAloon (2013, pg. 197): "After 1981, increasingly preoccupied with inflation, Muldoon [the then Prime Minister and Finance Minister] reversed previous liberalisation, re-regulated financial markets, froze wages and prices, and had Parliament enact what was effectively a property speculation tax of the sort he had vehemently opposed in 1975".

In the article we talk about the institution governing monetary policy prior to the reform as generating uncertainty owing to it not being an effective constraint on those implementing monetary policy. The Reserve Bank of New Zealand Act (1964) required monetary policy to maintain and promote: "economic and social welfare in New Zealand, having regard to ...promoting the highest level of production and trade and full employment, and of the maintaining a stable internal price level."³⁴ Evans et al. (1996, pg. 1864) notes this meant there was "inconsistent application of monetary policy towards a particular target" meaning "it could be directed towards whatever short-term problems was uppermost of the government's agenda (including reelection)". Sullivan (2013, pg. 7) notes during the 1970s: '[a]s well as exchange rate control to aid the export industry and/or address the balance of payments issues, monetary policy was attempting to control the flow of capital and credit growth. At various times the RBNZ, as directed by the Minister of Finance, implemented capital controls, set interest rate ceilings for lending and borrowing, abolished interest rates for on-call deposits, set lending limits, set and altered reserve ratio requirements and required banks and finance companies to hold certain levels of government stock.'

The lack of clear rules for the conduct of fiscal policy meant it too focused on constantly shifting targets. Post the terms of trade fall in the mid-1970s, the government adopted the view that *economic growth should be maintained* to get through the crisis and increased its overseas borrowing to fund its own expenditure (Dalziel & Lattimore, 2001). However, the resulting increases in the balance of payments and budget deficits promoted a change in direction in the 1976 Budget: *solvency* became the new goal. Falling domestic demand meant unemployment followed. In 1979, the strategy shifted away from fiscal consolidation to *export promotion* via increased subsidies and reducing external protection (Easton, 1997). The second oil shock (occurring in 1979) and the *desire to reduce the dependence on imported fuel and boost employment* resulted in a number of large construction projects in the energy sector (collectively termed 'Think Big') in the early 1980s. Finally in 1982, *inflation* became the target (despite the balance of payments not improving): a wage-price freeze was implemented in response.

³⁴Reserve Bank of New Zealand Act 1964; as quoted in Evans et al. (1996, pg. 1864).

We also note in our article that poorly functioning institutions can also give rise to uncertainty through unpredictable changes in how key prices and quantities are determined. An example of this in the New Zealand pre-reform context concerns labour market institutions. Wage setting in New Zealand from the end of the war until 1968 had been successfully governed via the Arbitration Court system. In the event unions and the employer organisations could not reach an agreement on pay and conditions, the Court set binding minimum pay and conditions for the group of workers (Easton, 1997). The labour market institutions reflected both a formal institution (a set of rules around how the dispute would be resolved) and an informal institution (that all parties would respect the Court's judgement). However, in 1968 the Arbitration Court issued a nil-wage order despite considerable consumer price inflation (McAloon, 2013). The order was seen as 'open invitation for further and more serious industrial dissension'.³⁵ Further, the government stopped abiding in all cases by the informal institution of respecting the Court's judgement. In July 1979] a group of ministers following a judgement they disagreed with] 'recommended repealing the General Wage Order Act in favour of a new Remuneration Act allowing the government to regulate pay and conditions. This was a complete reversal of the 1977 return to free bargaining...' (McAloon, 2013, pg. 189). The possibility of both industrial dissension and switching between governmental interference and free-bargaining would have added considerable uncertainty for firms about the level of wage growth (and potentially the availability of labour owing to disputes).

Another example of a set of poor institutions leading to uncertainty about a key price in the economy was the fixed exchange rate regime (which operated from 1931 to mid-1979 and mid-1982 and March 1985), coupled with interest rate controls. With interest rates unable to ensure appropriate adjustment in the capital account, the fixed exchange rate regime was characterised by large devaluations/ revaluations of the exchange rate that were not predictable both in the timing and magnitude (Quigley, 1992).³⁶ The prospect of large changes in the exchange rate meant firms in the tradables sector faced uncertainty about their input or export prices (or both).

Poorly-functioning institutions can also exacerbate the consequences of institutional uncertainty discussed above. North (1994, pg. 361) said: 'if the institutional framework rewards productive activities then organizations – firms – will come into existence to engage in productive activities'. Prior to 1984, the New Zealand government's use of the tax system to promote certain industries resulted in organisations and firms strong in taking advantage of the tax system rather than generating productivity gains. New Zealand agriculture prior to 1984 is a good example. In 1983, immediately prior to the reform, agricultural support accounted for 40 per cent of sheep farm income (Vitalis, 2007). This meant a significant proportion of farmers' income relied on decisions taken by the government, and normally economically irrational decisions—such as bringing a large area of marginal land into farm use—were taken to maximise the gains from the governmental assistance (Vitalis, 2007). This meant that rather than uncertainty about farm viability coming from the whims of commodity prices and climatic conditions, uncertainty about farm viability also reflected the whims of political favour and the policy choices of government. In such a situation, firms become more exposed to institutional uncertainty.

³⁵This quote is from Archie Grant, the workers' representative on the court, as quoted in McAloon (2013, pg. 136).

³⁶The crawling peg, which operated between 1979 and mid-1982, involved more frequent, smaller changes in the exchange rate, so it was less of a source of uncertainty than the fixed rate regime but still a source of uncertainty.

Appendix 2: Additional information on the Quarterly Survey of Business Opinion

Since 1961, the Quarterly Survey of Business Opinion (QSBO) has continuously surveyed New Zealand firms. The first sector in the survey was manufacturers and firms from various sectors were added to the survey at different points in time; merchants who were retailers were the last to be added in 1974 (Silverstone, 2006). More information on the QSBO, its history and its use in research is available in Silverstone, 2006, Buckle & Silverstone, 2011, and O'Connor & Allen, 2011).

Linking responses to the QSBO

We need to be able to link a firm's response in time $t-1$ to their response in time t to create the two expectation errors indices. Figure 2.9 shows the number of firms in time $t-1$ that are able to be linked to time t for each survey. The solid horizontal line at 30 responses represents what we have imposed as the minimum acceptable sample size in a given quarter. If there are not that many missing values in the sample for the quarter, we impose a null/missing value for that quarter and then interpolate the index based on the surrounding quarters.³⁷

Questions in the QSBO

Table 2.3 shows the economic concepts asked about in (or topics of) the questions in the QSBO. The table breaks the questions down into those that are common to all sectors (apart from Architects) and questions that are specific to manufacturers, builders and merchants.³⁸ In constructing our indices, we do not restrict ourselves to topics/questions that are common between all sectors; we make use of all the topics/questions available for the given sector. The table has three columns. The first column states topics/ economic concepts where there is a question asking about expectations of the future as well as experienced activity. These questions are used for both our expectation errors and dispersion-based uncertainty proxies. The second column states topics/ economic concepts where there is a question about expectations of the future only; these are used for our dispersion-based proxy. The final column contains topics of questions that we do not use as their answers are not in a form that allows us to create the aforementioned proxies.³⁹

³⁷Interpolated using the spline interpolation procedure in the `imputeTS` R package; owing to a smaller sample, 15 is the minimum required sample for the Financial Services sector.

³⁸Architects have their own more idiosyncratic set of questions and they are excluded from our study.

³⁹For example, the 'limiting factor' question asks which factor, from a supplied list, is limiting the firm increasing its turnover.

TABLE 2.3: The economic concepts asked about in the QSBO questions

Expected and experienced	Expected	Other
Common		
Average cost	General business situation	Limiting factor
Average price	Investment in buildings	
Numbers employed	Investment in buildings	
Overtime	Finding skilled labour	
Profits	Finding unskilled labour	
Volume		
Labour turnover		
Manufacturers, Builders and Merchants		
Debtors		
Orders		
Delivery/exports overseas		
Delivery/sales NZ		
Merchants only		
Stock (value and volume)		
Manufacturing/builders only		
Output		Present stock
Production	Capacity Utilisation	
Finished goods		
Stock (raw and finished)		

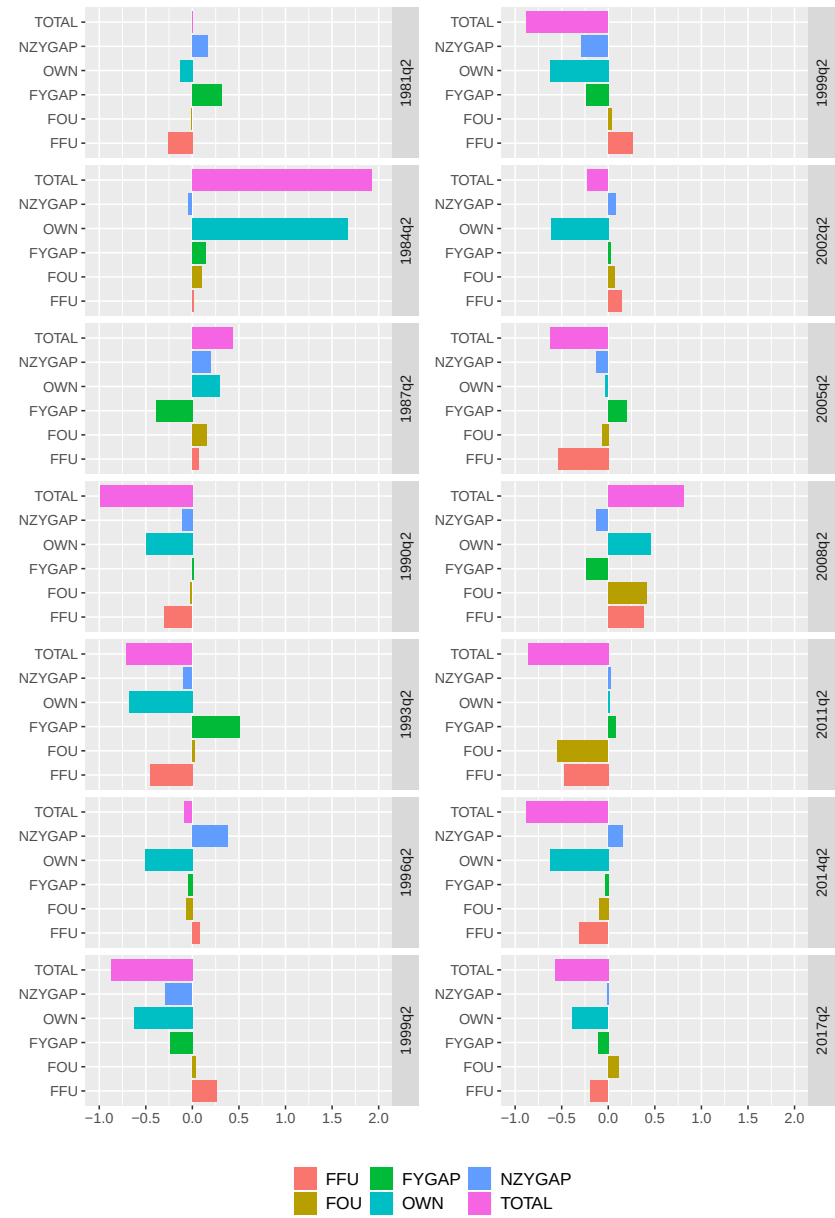


FIGURE 2.6: Historical contribution of all shocks to New Zealand uncertainty

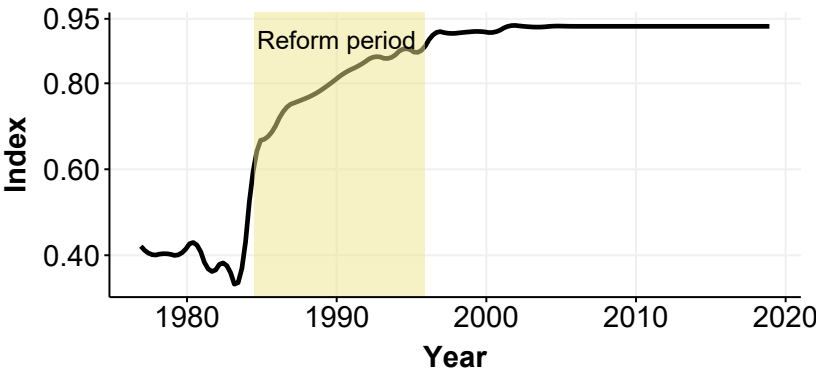


FIGURE 2.7: Measure of institutional status

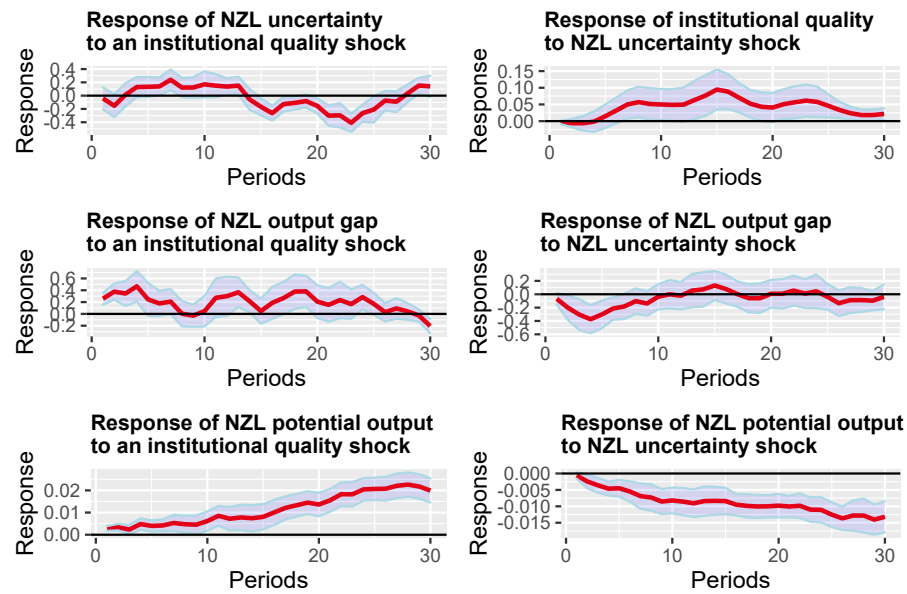


FIGURE 2.8: Impulse responses: Linear projections model with institutions

The solid line represents median responses of the variables to a unit shock to uncertainty (about one standard deviation) and a one standard deviation shock to institutional status. The shaded area represents the 90 per cent confidence bands.

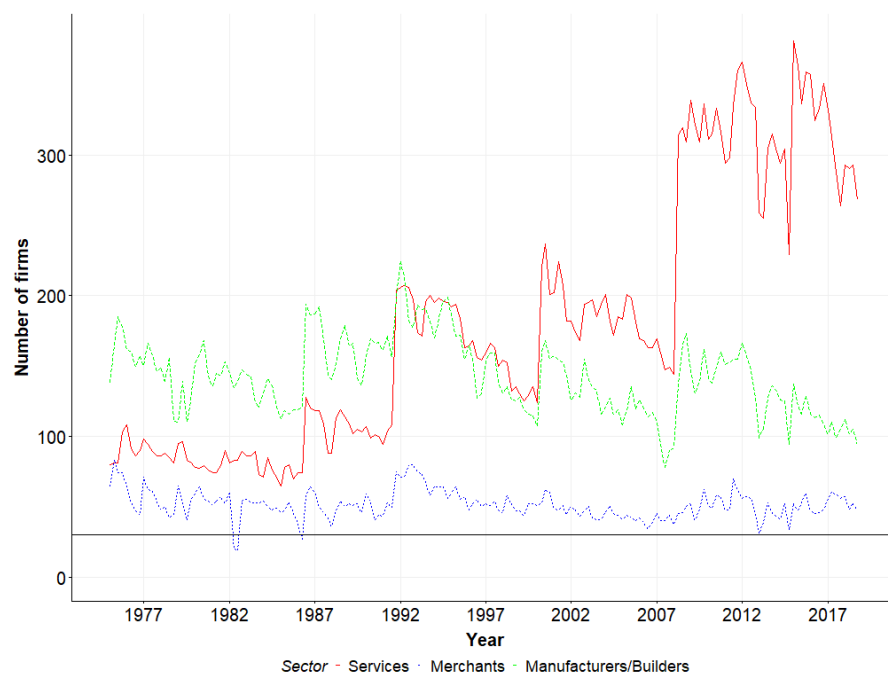


FIGURE 2.9: Linked Sample counts by sector

Appendix 3: Stochastic volatility-based uncertainty measure

To construct our overall measure of uncertainty, we use the New Zealand-specific uncertainty index of Berger et al. (2016) as an input. The index comes from estimating the following model:⁴⁰

$$y_{i,t} = \beta_i^0 + \beta_i^1 \pi_{i,t} + \tau_i R_t + I_{i,t} + \epsilon_{i,t} \quad (2.8)$$

where $y_{i,t}$ is output growth in country i in time t , β_i^0 is a country-specific constant and $\pi_{i,t}$ controls for inflation. R_t and $I_{i,t}$ represent the common (across countries) and idiosyncratic drivers of growth respectively. R and $I_{i,t}$ are assumed to follow the following processes:

$$R_t = \sum_{k=1}^2 \rho_k R_{t-k} + \exp(h_t) \zeta_t \quad (2.9)$$

$$I_{i,t} = \sum_{k=1}^2 \phi_k^i I_{i,t-k} + \exp(g_{i,t}) \eta_{i,t} \quad (2.10)$$

$$h_t = h_{t-1} + \gamma_t \quad (2.11)$$

$$g_{i,t} = g_{i,t-1} + \omega_t \quad (2.12)$$

where $\zeta_t, \eta_t, \gamma_t, \omega_t$ are all approximately $iid N(0, 1)$.

h_t and $g_{i,t}$ represent the common OECD and country-specific idiosyncratic stochastic volatility measures, respectively. Further, Berger et al. (2016) label h_t and $g_{i,t}$ as common OECD and country-specific uncertainty proxies, respectively. They explain country-specific uncertainty as domestically sourced uncertainty plus the country-specific impact of common OECD uncertainty.

The sample used in the paper runs from 1970Q1 to 2013Q4. Given our sample runs from 1975Q4 to 2018Q4, we used the authors' code to create a longer time span for the New Zealand-specific measure.⁴¹

Using more up-to-date data gives us broadly similar results as the original paper, although the New Zealand-specific uncertainty measure estimated on the more up-to-date data is less elevated in the pre-1984 era than the measure in the original paper. We suspect the effects of data revisions are at play.

⁴⁰This explanation of the Berger et al. (2016) model draws heavily on their paper.

⁴¹The GDP data are from the OECD:

https://stats.oecd.org/Index.aspx?datasetcode=SNA_TABLE1_ARCHIVE [accessed 20 December 2019]; the GDP data is real/volume-based and stated in PPP terms.

Appendix 4: Additional information on the Bayesian estimation of the SVAR models

We implement the models in the Bayesian Estimation, Analysis and Regression (BEAR) toolbox. The toolbox is a statistical package that has been developed by Roman Legrand, Alistair Dieppe and Bjorn van Rye of the External Developments Division of the European Central Bank. We are grateful that they have made this available publicly.

For the time-invariant model (TI-SVAR), the number of Gibbs sampling iterations are 10,000 with 5,000 burn-in iterations. The TI-SVAR uses a Minnesota prior. The time-varying SVAR model (TV-SVAR) uses 6,000 Gibbs sampling iterations with 1,000 burn-in iterations (as it is computationally more intensive); every 20th iteration is retained.⁴²

The following table reports the hyperparameters used to determine the priors. How these hyperparameters are used to determine the priors of the parameters of interest is set out in Dieppe et al. (2016).

TABLE 2.4: Hyperparameters used in Bayesian estimation of SVAR model

SVAR:time-invariant		SVAR: time-varying	
Lambda 1:	0.1	Gamma:	0.85
Lambda 2:	0.5	Alpha0:	0.001
Lambda 3:	1	Delta0:	0.001
Lambda 4:	100		
Lambda 5:	0.001		
Lambda 6:	1		
Lambda 7:	0.1		

The specific version of the time-varying model we estimate is:⁴³

$$y_t^{NZ} = A_{1,t}y_t^{NZ} + \dots + A_{4,t}y_{t-4}^{NZ} + C_t y_t^F \epsilon_t \quad (2.13)$$

where Y_t^F is the set of foreign variables: foreign financial uncertainty, foreign output uncertainty and the foreign output gap. Y_t^{NZ} is the set of New Zealand variables: uncertainty and the output gap.

The model can be expressed as:

$$y_t = \bar{X}_t \beta_t + \epsilon_t \quad (2.14)$$

⁴²The reader is referred to Dieppe et al. (2016) for more detail on the Gibbs sampling algorithm and the prior setup for the time-varying model.

⁴³The following exposition draws heavily from Dieppe et al. (2016).

where:

$$\bar{X}_t = I_n \otimes X_t, X_t = (y_{t-1}^{NZ'}, \dots, y_{t-4}^{NZ'}, y_t^{F'}) \quad (2.15)$$

and:

$$\beta'_t = vec(B_t) \quad (2.16)$$

$$B_t = \begin{bmatrix} A'_{1,t} \\ \vdots \\ A'_{4,t} \\ C'_t \end{bmatrix} \quad (2.17)$$

The VAR coefficients are modelled as following a first-order autoregressive process:

$$\beta_t = \beta_{t-1} + v_t, v_t \sim N(0, \Omega) \quad (2.18)$$

where Ω , the co-variance matrix, is endogenous.

In equation 2.14:

$$\epsilon_t \sim N(0, \Sigma_t) \quad (2.19)$$

We assume:

$$\Sigma_t = F \Lambda_t F' \quad (2.20)$$

where F is a lower triangular matrix with ones on the diagonal and Λ_t is a diagonal matrix:

$$diag(\Lambda_t) = (\bar{S}_1 exp(\lambda_1, t), \dots, \bar{S}_n exp(\lambda_n, t)) \quad (2.21)$$

We assume:

$$\lambda_{i,t} = \gamma \lambda_{i,t-1} + \vartheta_{i,t} \quad (2.22)$$

$$\vartheta_{i,t} \sim N(0, \phi_i) \quad (2.23)$$

Our time-varying model means both time-varying relationships between variables (via equation 2.18) and heteroskedasticity (via equation 2.22) are allowed for.

Appendix 5: How do different modelling specifications change the estimates of institutional uncertainty?

In section 3 of our paper we discussed our assumption that we can proxy institutional uncertainty by the historical contribution of New Zealand's uncertainty 'own shocks'. We noted there are other potential non-macroeconomic and financial factors that contribute to New Zealand's uncertainty 'own shocks'. To understand if any of these variables make a material difference to our estimates of institutional uncertainty, we conducted a number of robustness tests using the time-invariant SVAR as our baseline.⁴⁴

Our first robustness tests concern climate and natural disasters. We use the Southern Oscillation Index (SOI) as a variable to capture a potential source of climate uncertainty. The SOI measures the difference in surface air pressure between

⁴⁴We choose the time-invariant SVAR as our baseline as it runs the fastest.

Tahiti and Darwin and is used to predict weather patterns in New Zealand. According to the Australia Bureau of Meteorology: ‘sustained positive SOI values above about +8 indicate a La Niña event while sustained negative values below about –8 indicate an El Niño.’⁴⁵ El Niño events are typically associated with droughts in the east of New Zealand affecting agricultural production, while La Niña tends to result in lower summer flows into the hydroelectric lakes (McKerchar et al., 1998). We transform the SOI two ways for different specifications of models. The first transforms the SOI into two dummy variables. The first dummy variable, *La Niña*, takes a value of one if the SOI is greater than or equal to 8 and a value of zero otherwise. The second dummy variable, *El Niño*, takes a value of one if the SOI is less than or equal to -8 and a value of zero otherwise. In the second specification, we take the absolute value of the SOI. This means a high value of the index means either a La Niña or El Niño event is likely.

Natural disasters also are likely to be sources of uncertainty (see for example, Baker et al., 2016). We use cost data from the Insurance Council of New Zealand to create a variable to control for the effect of natural disasters on uncertainty.⁴⁶ We inflation adjust the cost data using Statistics New Zealand’s Consumer Price Index and express the cost of the natural disaster as a per cent of GDP. Including both the climate and the natural disaster data made no material difference to the estimates of institutional uncertainty.⁴⁷ Figure 2.12 plots the institutional uncertainty measure from the baseline specification discussed in the body of the paper against a ‘Scenario A’ which is the institutional uncertainty measure from the baseline VAR augmented with the natural disasters data and the *El Niño* and *La Niña* dummies. ‘Scenario B’ substitutes the absolute measure of the SOI for the SOI dummy variables.

We also carry out some other robustness tests. Scenario C adds the real effective exchange rate to the baseline SVAR;⁴⁸ scenarios D and E are the baseline SVAR estimated with eight lags and different priors respectively (specifically, the autoregressive prior is lowered from 0.8 to 0.1.) The institutional uncertainty measures associated with each of these scenarios are plotted in Figure 2.12. We also note in the paper that a shift from manufacturing to services might have lowered uncertainty through time (Fernández-Villaverde & Guerrón-Quintana, 2020). To test for this effect, we create our QSBO-based uncertainty measure with constant GDP weights (the weights in the first year of the sample period), rather than the weights updating annually as we do in our main specification. The institutional uncertainty measure associated with the constant-weight index is shown as scenario F in Figure 2.12.

Across all our robustness tests, the dynamics of the institutional uncertainty proxy remain consistent with the baseline scenario. Including the real exchange rate probably has the biggest effect but this still does not change what one infers from the institutional uncertainty proxy: institutional uncertainty rose immediately prior to the reform, remained elevated during the reform and then fell post reform.

⁴⁵<http://www.bom.gov.au/climate/enso/history/ln-2010-12/SOI-what.shtml> [accessed 14 January 2020].

⁴⁶Available at <https://www.icnz.org.nz/natural-disasters/cost-of-natural-disasters/> [accessed 7 February 2020]

⁴⁷Looking at the estimated impulse responses (not reported), it appears that climatic events and natural disasters affect the output gap more than New Zealand uncertainty. Climatic events have a negative effect on the output gap; this is consistent with lost agricultural production. Natural disasters have a positive effect on the output gap. Natural disasters destroy some of the stock of capital, but this is not subtracted from GDP; the rebuild of this capital stock is, however, counted and adds to GDP.

⁴⁸The exchange rate data was sourced from the Bank of International Settlements (narrow version of the effective exchange rate): <https://www.bis.org/statistics/eer.htm> [accessed 20 November 2019].

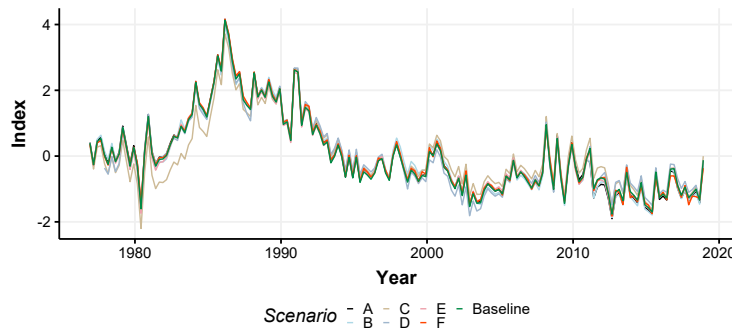


FIGURE 2.10: Historical decomposition of own shocks to New Zealand uncertainty after alternative model specifications

Appendix 6: Alternative method to testing for structural breaks

We inferred from our unknown structural break test results in section 4 of our article that uncertainty was lower post-reform than prior to reform. To test the robustness of this result we estimate this regression:

$$UNZ_{unz,t} = c + \gamma_1 * Reform + \gamma_2 * PostReform + \varepsilon_t \quad (2.24)$$

where $UNZ_{unz,t}$ is our proxy for uncertainty from institutional sources. *Reform* is a dummy variable covering period 1984Q3 to 1995Q4 and *PostReform* is a dummy variable covering the period 1996Q1 to 2018Q4. If the reform was successful in reducing uncertainty from institutional sources, then we would expect $\gamma_2 < 0$; that is, the average level of uncertainty is lower pre-reform than post-reform. We estimate the model twice: once for each measure of institutional uncertainty.

In our initial estimation, we found low values of the Durban-Watson statistic (in the region of one or lower), indicating positive autocorrelation is present. We re-estimated the model with a lagged dependent variable; Table 2.5 reports the results. In both of our models, relative to the pre-reform period, the reform period had a higher level of institutional uncertainty on average, and the post-reform period had a lower level of institutional uncertainty on average (with the differences pre- and post-reform being statistically significant at the one per cent level).

Appendix 7: Measuring institutional status

The measure

A quantitative measure of the change in the functioning of New Zealand's institutions will always be imperfect. We make use of the market liberalisation indicators of Prati et al. (2013). The first three graphs in Figure 2.11 plot various liberalisation indicators for New Zealand from Prati et al. (2013). All indicators are re-scaled to range between 0 and 1, with higher values corresponding to a greater degree of liberalisation.⁴⁹ In terms of the individual indicators, 'Trade' measures tariff rates, while 'capital' and 'current' reflect restrictions on the respective external accounts. The financial indicators measure various aspects of domestic financial liberalisation

⁴⁹The scaling occurs relative to all countries, so it is not necessary that New Zealand will ever score a zero or a one.

TABLE 2.5: Regression Results: Reform and post-reform dummies

	<i>Dependent variable is institutional uncertainty from the:</i>	
	TI-SVAR (1)	TV-SVAR (2)
Reform	0.206 (0.147)	0.138 (0.129)
Post_reform	−0.316** (0.133)	−0.259** (0.119)
Lagged dep. variable	0.721*** (0.057)	0.549*** (0.067)
Constant	0.122 (0.106)	0.133 (0.099)
Observations	168	168
R ²	0.770	0.502
Adjusted R ²	0.765	0.493

Note: Standard errors are in brackets

*p<0.1; **p<0.05; ***p<0.01

(such as the lack of controls on credit and interest rates; the degree of competition; the quality of regulation). In the other indicators graph, ‘Agriculture’ and ‘Network’ refer to the degree of liberalisation in the agriculture, and the telecommunications and electricity sectors respectively and measure the extent of state intervention and the quality of regulation (in the case of telecommunications).⁵⁰ For our purposes, it is enough to note the rapid increase in liberalisation occurs across most indicators post 1984; with the exceptions being in network industries (which were corporatised and privatised in the late 1980s) and the slower progress made on reducing tariff rates.

The indicators in the fourth graph (the lower right panel) in Figure 2.11 are our creations. The first (‘total index’) is a straight arithmetic average of all indicators in the other three graphs. It measures the overall extent of liberalisation and is the measure we use in our paper. The second indicator (‘% change in the index’) is the percentage change in the total index.

Did the reforms lower institutional uncertainty? A robustness test using the explicit measure of institutional status

In Appendix 6, we regressed our measure of institutional uncertainty on dummies for the reform and post-reform period to test if institutional uncertainty had fallen in the post-reform period. As an alternative test, we use the liberalisation index we developed above. The regression contains two variables: the overall level of institutional liberalisation (‘Overall_q’) and the percentage change in the total index (‘change_q’)—the latter variable will be high during the reform as the overall index will be changing rapidly. Table 2.6 shows the results. We see in both models that the higher the level of liberalisation status, the lower the level of institutional uncertainty, which indicates the reform lowered institutional uncertainty; this is consistent

⁵⁰For the sake of brevity, the reader is referred to Prati et al. (2013) for a detailed description of each indicator.

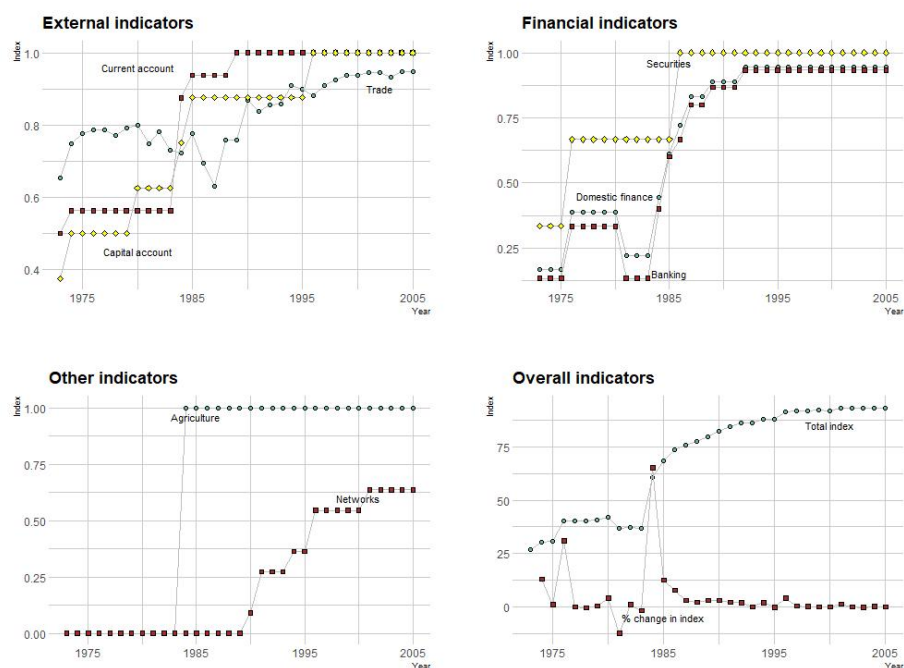


FIGURE 2.11: Measures of market liberalisation

with our results in the main paper. Further the change_q variable is positive and statistically significant in table 2.6 indicating uncertainty increased during the reform period. A finding also consistent with the results in the main paper.

TABLE 2.6: Regression Results: alternative reform measure

	<i>Dependent variable is institutional uncertainty from the:</i>	
	TI-SVAR (1)	TV-SVAR (2)
Overall_q	−0.423* (0.241)	−0.401* (0.222)
Change_q	1.024** (0.404)	0.980*** (0.370)
Lagged dep variable	0.806*** (0.043)	0.608*** (0.060)
Constant	0.309 (0.199)	0.315* (0.185)
Observations	168	168
R ²	0.767	0.499
Adjusted R ²	0.763	0.489

Note: Standard errors in brackets

*p<0.1; **p<0.05; ***p<0.01

Appendix 8: Instrumental variable estimation of the local projections model

If, as we discuss in our article, our institutional status variable in our linear projection model suffers from measurement error, so will our estimate of shocks to institutional status. The result is attenuation bias in our estimated impulse responses. Ramey and Zubairy (2018), in the context of estimating the impact of government spending on the economy, propose a solution using instrumental variable estimation of the local projection model. In one formulation of their model, they use government spending shocks from a Structural VAR to instrument the government spending variable. Analogously we could use our institutional status shocks (from our time-invariant SVAR) as instruments for the first difference of our institutional status variable (we first difference our institutional status variable as it is non-stationary). There are two conditions for instruments that are conventionally required to be met: the relevance of the instrument to the variable of interest and contemporaneous exogeneity with other shocks. In terms of the relevance of the instrument, the heteroskedasticity and autocorrelation robust F-statistic from regressing the first difference of our institutional status variable on our institutional status shocks (from our time-invariant SVAR) is 26.95; this is higher than the ‘rule of thumb’ of 10 as set out in Stock and Yogo (2005).⁵¹ In terms of instrument exogeneity, with the other shocks this is more difficult to assess as the other shocks are not directly observed. One imperfect test is to look at the correlation between the institutional status shock and the other shocks identified in the time-invariant SVAR; this is reported below in table 2.7. We see no evidence of a lack of contemporaneous exogeneity at a five per cent statistical significance level. Stock and Watson (2018) also illustrate the need for a third condition when using instrumental variables with local projections: lead/lag exogeneity. This requires no correlation between our shock of interest, and leads and lags of the other shocks. We look at the correlation between the institutional status shock and the $t - 4, \dots, t - 1$ lags and $t + 1, \dots, t + 4$ leads of the other shocks identified in the time-invariant SVAR. In three instances we find a correlation that is significant at a five per cent level; this suggests caution in interpreting our results.⁵²

TABLE 2.7: Correlations between other shocks and the institutional status shocks

Shock	Correlation	P-value
Foreign financial uncertainty	0.11	0.16
Foreign output uncertainty	0.11	0.15
Foreign output gap	-0.00	0.99
NZ uncertainty	-0.08	0.33
NZ output gap	-0.05	0.56

Below we present the impulse responses from the local projections for a positive change in institutional status when we use the shock as an instrument. For comparability, the shock is the same size as one presented in figure 8 in our article. There is little real difference in the results between the figure below and figure 8.

⁵¹We use autocorrelation-robust standard errors owing to a low Durbin-Watson statistic. A better test would be to use the test of Olea and Pflueger (2013).

⁵²These instances are: the first lag of the foreign uncertainty shock, the second lag of the foreign output shock and the fourth lag of the New Zealand uncertainty shock.

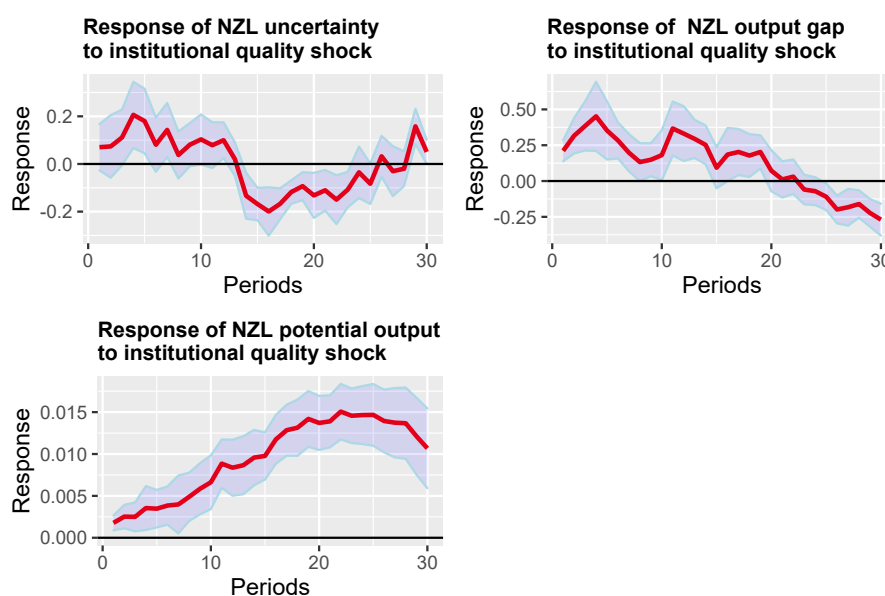


FIGURE 2.12: Impulse responses to an institutional status shock: LP model with instrument

The solid line represents median responses of the variables to a one standard deviation shock to institutional status as reported in figure 2.8. The shaded area represents the 90 per cent confidence bands.

Chapter 3

New Zealand's lauded fiscal legislation: has it reduced fiscal uncertainty?

Abstract

The two pieces of legislation that govern New Zealand's fiscal policy and fiscal management are much lauded and even copied. Both pieces of legislation contain provisions to reduce the uncertainty from fiscal policy. This paper evaluates their success in reducing net taxation and government spending uncertainty. We find the legislation probably reduced net taxation uncertainty. We are less certain, however, if the reduction in government spending uncertainty we observe is due to the legislation or due to a reduction in worldwide volatility (aka the great moderation). That the legislation reduced net taxation uncertainty is a positive as we also show that net tax uncertainty is more detrimental to output than government spending uncertainty.

3.1 Introduction

New Zealand's Public Finance Act (1989) just celebrated its 30th anniversary, and the Fiscal Responsibility Act (1994) is only a few years off that mark. These two pieces of legislation are key institutions in governing fiscal policy and management in New Zealand.¹ Significant anniversaries are often a time for reflection and, in the case of these two pieces of legislation, this reflection has begun. The title of an opinion piece on the Public Finance Act (1989) on its 30th anniversary, by one of its architects, stated the: 'Public Finance Act has proved its worth in good times and bad';² similarly, Gill (2018, p. i) states '[t]he Fiscal Responsibility Act 1994 is an astonishing success story of a weak non-binding policy instrument'. There is no doubt the pieces of legislation have been associated with successful outcomes: the government's net worth has improved and the government has run sustained fiscal surpluses since their implementation (Gill, 2018, p. i).

North (1991a) stated that institutions, such as laws, are created by humans to reduce uncertainty. This paper, therefore, argues that another relevant metric by which to assess these pieces of legislation is on whether they have reduced uncertainty, specifically fiscal uncertainty. Indeed, there are provisions in both Acts which can be interpreted as seeking to reduce uncertainty. In addition, to the principles of

¹The original provisions of the Fiscal Responsibility Act 1994 were subsequently folded into the Public Finance Act 1989 in 2004 (Gill, 2018).

²<https://www.stuff.co.nz/national/politics/opinion/114464570/public-finance-act-has-proved-its-worth-in-good-times-and-bad>[accessed 8 February 2022].

reducing 'debt to a prudent level' and once that is achieved, of ensuring that 'over a reasonable period operating expenditure does not exceed operating revenue', the Public Finance Act (1989) requires that the 'government pursue policies which are consistent with maintaining a reasonable degree of predictability about the level and stability of taxation rates in the future' (Barker et al., 2008, p. 34). Further, there are various reporting requirements to set out forecasts and intentions over various periods of time. By requiring the government, via the Fiscal Strategy Report, to state their short-term fiscal intentions and long-term fiscal objectives for fiscal policy, the Fiscal Responsibility Act sought to reduce the public's uncertainty concerning policy, as it provides, in the words of Gill (2018, p. 10), a 'commitment device'.

Not all readers, on the face of it, will be interested in the success or otherwise of two pieces of legislation in a small country at the bottom of the world. However, we would argue there are reasons they should be. Firstly, for those readers interested in the structure and nature of institutions, the Fiscal Responsibility Act is interesting. As Gill (2018) points out, the Fiscal Responsibility Act is not legally enforceable, and thus it does not bind the government; it is only because both major parties in the New Zealand parliament have endorsed it, that there is an enforcement mechanism in place: political pressure. As Treasury (2015, p. 6) notes, the requirements of the Act to outline intentions and objectives approximate 'the legislated fiscal rules of other countries, with the difference being that specific targets are not set down in law.'

Secondly, the pieces of legislation are much lauded—a former Director of the Fiscal Affairs Department at the International Monetary Fund, said:³ 'New Zealand has pioneered, and refined over the years, comprehensive fiscal reporting requirements, intended to ensure transparency, and to promote time consistency and a broad debate of the fiscal policy choices of successive Governments'. Further, many countries have adopted similar pieces of legislation; Gill (2018) states: 'New Zealand's pioneering approach based on fiscal transparency was followed by other countries including Australia with the Charter of Budget Responsibility Act (1998) and the United Kingdom with the Charter for Budget Responsibility (2011)'.

Thus what we learn from studying New Zealand's legislation will apply to other countries that have adopted similar legislation (or are considering it).

The specific research question this paper studies is: did the change in laws constraining and informing the conduct of fiscal management and fiscal policy in New Zealand lead to a reduction in fiscal policy uncertainty? In particular, were government spending uncertainty and net tax uncertainty reduced? The chief contribution of this paper is an econometric-based evaluation of whether these two pieces of world-leading legislation did indeed reduce fiscal uncertainty. The second contribution of this paper is to show which type of fiscal policy uncertainty is more detrimental to the New Zealand economy. In line with studies from other countries, we find that net tax uncertainty is more damaging.

The paper is structured as follows. Section 3.2 describes the data we use, as well as our modelling framework. Section 3.3 reports our results and section 5.6 concludes.

³Ter-Minassian, T. (2014). External Review of the Treasury's Fiscal Policy Advice; available <https://www.treasury.govt.nz/sites/default/files/2014-10/tfpa-2908566.pdf>

3.2 Data and modelling framework

Our modelling setup requires four fiscal series: government consumption and investment (collectively government spending), and tax and transfers (collectively, revenue or net tax, which is tax minus transfers); all variables are on a per capita basis and in real (2009/10 dollar) terms. There have been a number of changes in accounting practices for the New Zealand Crown accounts through the years: the change from cash to accrual/GAAP accounting principles in 1994 being the most significant. This complicates creating a long time series of fiscal data containing a significant pre-legislation-implementation period. The government consumption, government investment, tax and transfer series we use are taken from the dataset used in Claus et al. (2006) (further updated by Dungey & Fry, 2009 and then by Treasury analysts); these authors, either employed by the Treasury or under contract to the Treasury (Dungey and Fry) appear to have done as best they could to reconcile the series constructed under different arrangements. The fiscal data series in this dataset are available from 1982Q2 to 2010Q4.⁴

In order to conduct the analysis, we use the model of Popiel (2020) which we will explain in more detail below. This model is estimated using Bayesian methods and uses a training sample to calibrate its priors. As we do not want to lose too many observations in the pre-legislation-implementation period, we extend back the fiscal data series using the Chow-Lin procedure. To do this, we use annual values from various sources and use indicator variables to do the quarterly interpolation. The specific details of the variables are in table 3.1 below.⁵

Nominal fiscal series	Annual series
Government consumption	Real series from Dalziel and Lattimore (2001); nominal series created using nominal their GDP deflator
Government investment	As above
Tax	NZ Treasury Historical Fiscal Indicators 1972-2021 (NZTFI)
Transfers	NZTFI (Govt superannuation and welfare)
Nominal fiscal series	Quarterly Indicator
Government consumption	rgdp; cpi; OTIPM; OTIPX
Government investment	cpi
Tax	rgdp; cpi; OTIPM; OTIPX; wkagepop
Transfers	ur; cpi; deppop

TABLE 3.1: Variables used in the construction of backdated series

Abbreviations used above: Real GDP (rgdp); Consumer Price Index (cpi); Overseas Trade Index: Import prices (OTIPM); Overseas Trade Index: Export prices (OTIPX); Working age population (wkagepop); Unemployment rate (UR); Dependent population (deppop)

It is important to note that our fiscal uncertainty estimates are not based on the backdated sample and that the backdated sample is only used as a training sample to initialise the priors.

⁴We are grateful to the New Zealand Treasury for supplying the data.

⁵We impose that all quarterly totals need to sum to the annual totals; we use the maxlog method in R's tempdisagg package (Sax & Steiner, 2013). We also create a backdated quarterly GDP deflator from the annual series of Dalziel and Lattimore (2001). The indicator variables used are rgdp, OTIPM, OTIPX, cpi.

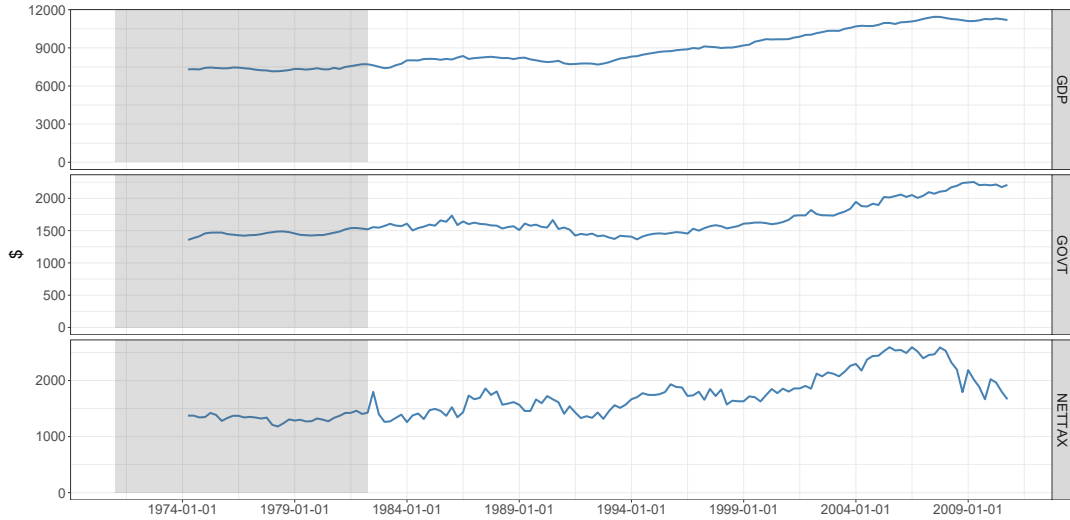


FIGURE 3.1: Variables used in the estimation of the VAR

All variables are real (volume measures) in 2009/10 dollars

Figure 3.1 plots real government spending and net tax/ revenue per capita series;⁶ the grey shaded area indicates the observations which are backdated. The real GDP per capita series is also plotted as this is the third variable in the model; this series is from Hall and McDermott (2011) but rebased into 2009/10 dollars.⁷ Despite the grey shading the real GDP series is not backdated on a quarterly basis.

Our empirical framework for measuring government spending and net tax (revenue) uncertainty is the model developed by Popiel (2020). Popiel (2020) expands on the model of Blanchard and Perotti (2002) to allow for stochastic volatility. Starting with the Blanchard and Perotti (2002) model, the model estimates the effects of surprise government spending and net tax changes on GDP using a Structural VAR model. The model starts from a reduced form of:

$$y_t = C + \sum_{i=1}^{i=p} \Gamma_i y_{t-i} + u_t \quad (3.1)$$

where y_t is a vector containing (natural log of the following variables): real net taxation per capita (taxation minus revenue), real government spending per capita (consumption plus investment) and real GDP per capita. C is a matrix containing a constant and, in some specifications, a trend term. In estimating the model, the number of lags, p , is set to four, consistent with other studies (Popiel, 2020; Claus et al., 2006).⁸ The above equation can be estimated by OLS to obtain the reduced form errors, u_t .

⁶Any real series in this paper is deflated by the GDP deflator. The per capita series is created by dividing the corresponding aggregate real series by our quarterly population estimates. Our quarterly population estimates are based on interpolation of the March annuals implied when the nominal GDP reported at Data1850 (see <https://data1850.nz/about/>) is divided by the nominal GDP per capita series reported at the same source.

⁷At Data1850 they have extended the original series of Hall and McDermott (2011) forward and rebased it.; <https://data1850.nz/about/>

⁸Again, as this is a Bayesian model, the maximum lag length is less important. This is because the prior on each lag converges towards zero as the lag length gets larger. We set four lags as our maximum lag length, just in case there is any unaccounted for seasonality in the data.

The contemporaneous relationship between the reduced form errors, u_t and structural shocks, ϵ_t , takes the following form:

$$u_t = \beta H^{1/2} \epsilon_t, \epsilon_t \sim N(0, I) \quad (3.2)$$

where the H matrix normalises the structural shocks to have a unit variance.

$$H = \begin{bmatrix} \sigma_\tau^2 & 0 & 0 \\ 0 & \sigma_g^2 & 0 \\ 0 & 0 & \sigma_y^2 \end{bmatrix} \quad (3.3)$$

The structural shocks we wish to identify are composites of reduced form errors and other structural shocks.

$$\epsilon_t^\tau = a_1 \epsilon_t^y + a_2 u_t^g + a_3 u_t^\tau \quad (3.4)$$

$$\epsilon_t^g = b_1 \epsilon_t^y + b_2 u_t^\tau + b_3 u_t^g \quad (3.5)$$

$$\epsilon_t^y = c_1 \epsilon_t^\tau + c_2 \epsilon_t^g + c_3 u_t^y \quad (3.6)$$

In order to identify the structural shocks, we need to place some restrictions on equations 3.4, 3.5, and 3.6. Following Blanchard and Perotti (2002), and others, we set b_1 equal to zero; that is, we assume government spending does not respond automatically to surprise changes in GDP. Following Hamer-Adams and Wong (2018), who use a similar framework in a New Zealand context, we set a_1 , the tax to output elasticity, to 1.2.⁹ Following Claus et al. (2006) and Popiel (2020), we set $a_2 = 0$; that is we order net taxes ahead of government spending. We are assuming that net taxes do not respond to government spending changes in the same quarter.

To incorporate fiscal uncertainty into the model, Popiel (2020) augments equations 3.1 and 3.2 with additional terms that allow for stochastic volatility:

$$y_t = C + \sum_{i=1}^{i=p} \Gamma_i y_{t-i} + \psi_1 \log(h_t) + u_t \quad (3.7)$$

$$H = \begin{bmatrix} h_\tau & 0 & 0 \\ 0 & h_g & 0 \\ 0 & 0 & h_y \end{bmatrix} \quad (3.8)$$

and adds the following equation to define the equation of the time evolution of the time-varying variances of structural shocks, h_t :

$$\log(h_t) = \mu + \rho \log(h_{t-1}) + v_t, v_t \sim N(0, Q) \quad (3.9)$$

In equation 3.9, ρ is a diagonal matrix of autoregressive coefficients and Q 'is a diagonal matrix of variances of the second moment innovations' (Popiel, 2020, p. 4). Most importantly, $h_t = h_\tau, h_g, h_y$ are the time-varying variances of the structural shocks. Following Popiel (2020, p. 4), we use the square root of the time-varying variances of structural shocks as our estimates of uncertainty as they represent the dispersion of the one-step ahead forecast errors (Popiel, 2020). In equation 3.7, it is assumed, as in Popiel (2020, p. 4), that fiscal uncertainty only affects other variables

⁹This is slightly higher than the value of one used by Claus et al. (2006) and Parkyn and Vehbi (2014).

in the model contemporaneously, although we will relax this assumption to test the sensitivity of our results.

The model is estimated via Bayesian methods (see Popiel, 2020 for more details). We use the initial 40 observations as our training sample to calibrate the model's priors. Therefore our training sample is 1972Q1 to 1982Q1 and our estimation sample is 1982Q2 to 2010Q4. All estimates from the model presented in the rest of the paper are based on the last 15,000 of the 20,000 draws from the Gibbs sampler.

There are two possible trend specifications: one where the trend is assumed to be stochastic, and one where the trend is assumed to be deterministic. Results from a Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test (Kwiatkowski et al., 1992) on the log of the three variables are reported below and show tax, government spending and GDP all reject the null hypothesis of stationarity at a one per cent level in both the trend and intercept, and intercept only specifications. We, therefore, prefer the stochastic trend (growth rate) version of the model.

	ln(Net tax)	ln(G)	ln(Y)
Trend, intercept	0.35***	0.29***	0.32***
Intercept	1.43***	1.09***	1.32***

TABLE 3.2: KPSS tests of stationarity of three series in line model

3.3 Results

3.3.1 Model validation

Before we report on the uncertainty estimates from our model, we wish to try and validate the model—that is see if the structural shocks are properly identified. The first results we present are the impulse responses of output to a surprise government spending increase and a surprise net tax *cut* (see figure 3.2).¹⁰ Following Mertens and Ravn (2014) and Popiel (2020), the fiscal shocks are normalised by their average ratio to GDP. This means they can be interpreted as the dollar changes in GDP as a ratio of the dollar changes in government spending or tax revenues (Mertens & Ravn, 2014, p. S3). We see that the surprise tax cut results in output growth as expected. However, a surprise government spending increase has a negative but statistically insignificant effect on output.

There have been numerous studies attempting to quantify the impact of fiscal variables on the New Zealand economy: Claus et al. (2006), Dungey and Fry (2009), Parkyn and Vehbi (2014), Fielding et al. (2011), Hamer-Adams and Wong (2018), Power and Haug (2021) and Lyu (2021). Reviewing these studies, it is clear that the results are very sensitive to the specification used, identification assumptions and the sample period; Figures 1-6 in Fielding et al. (2011), which report on sensitivity tests on various models, illustrate this point very well. It is hard, therefore, to identify a set of stylised facts that our model should match. As our model is closest to Claus et al. (2006), Parkyn and Vehbi (2014) and Hamer-Adams and Wong (2018) in specification, identifying assumptions, and sample period, we will discuss our results with reference to these papers.

¹⁰Consistent with Popiel (2020), we report 68 per cent credible sets throughout this paper. The justification is set out by Blake, Mumtaz, et al. (2012, p.40): "[n]ote that 68% error bands are typically shown as the 90% or 95% bands can be misleading if the distribution of the impulse response function is skewed due to non-linearity"

TABLE 3.3: Estimates from relevant previous studies

Sample		Claus et al. (2006) 1982Q3 to 2004Q3 1	Dungey and Fry (2009) 1983Q1 to 2010Q2 2	Parkyn and Vehbi (2014) 1983Q2 to 2006Q4 2	Hamer-Adams and Wong (2018) 1990Q3 to 2017Q3 2	This paper 1992Q2 to 2010Q4 3
Increase in G	Impact	0.13	0.24	0.26	0.43	0.12
	One year	0.25		0.42	0.24	0.15
Tax cut	Impact	0.25	-0.29	0.23	0.24	0.1
	One year	0		0.1	-0.1	0

Notes: 1: Stochastic trend version of model and reported estimates are only approximate as they are based on eyeballing their figures; 2: As reported in Hamer-Adams and Wong (2018); 3: Model has a training sample of 1982Q2 to 1992Q2

If we restrict our sample to 1982Q2 to 2010Q4, we get a similar dynamic output response from a government spending increase to Claus et al. (2006),¹¹ as shown in figure 3.3. This smaller sample is more in line with the sample they use (see table 3.3). Relative to other relevant studies (in terms of sample, identification method), Table 3.3 shows we are broadly comparable in terms of the effects of government spending on output. In terms of the effects of tax cuts, we get a much smaller initial impact on GDP from a tax cut but similar (very small) effects after a year.¹²

The inclusion of the 1972 to 1982 period in our (training) sample leads to markedly different results to when we truncate the sample. An explanation for this is that the period 1972 to 1982 was a somewhat idiosyncratic time in New Zealand economic history. Wells (1987) notes during this period the government's use of fiscal policy as a stabilisation tool increasing had a short-run focus, leading to a 'diminution in its effectiveness, because private sector producers and consumers had little confidence that a particular set of policies would be sustained' (p. 284). Also during this period, there were a number of large, government-funded, capital projects in the energy sector (called the 'think big' projects) and these projects had a large import component (see Dalziel & Lattimore, 2001, p. 19). Both statements above suggest that a government spending shock will have a small impact on output.¹³

The purpose of this exercise was to try and see if the structural shocks are properly identified. We tentatively conclude the structural shocks are properly identified for three reasons. One, the model produces estimates similar to previous studies when estimation is restricted to roughly the same period. Two, we can (potentially) explain why our model does not concur with other models regarding the output effect of government spending in our longer sample (the nature of government spending in the non-overlapping period). Three, Fielding et al. (2011) showed the estimated output effects in New Zealand of fiscal policy are extremely sensitive to identifying assumptions and the sample period. They show models can sometimes give counter-intuitive results, such as expansionary tax increases. With this in mind, our lack of counter-intuitive results is encouraging

¹¹So this model has a training sample of 1982Q2 to 1992Q1 and an estimation sample of 1992Q2 to 2010Q4.

¹²Note we have adjusted our estimates in table 3.3 so they are on the same basis as the other studies (per cent change in GDP).

¹³A third possible explanation is data related. We use the period 1972Q1 to 1982Q1 as the training sample for our priors, and estimate the model from 1982Q2 to 2010Q4—the same period for which we have quarterly data from Treasury. However, the training sample is interpolated from annual data and, potentially, it is the interpolated sample that is causing the issue.

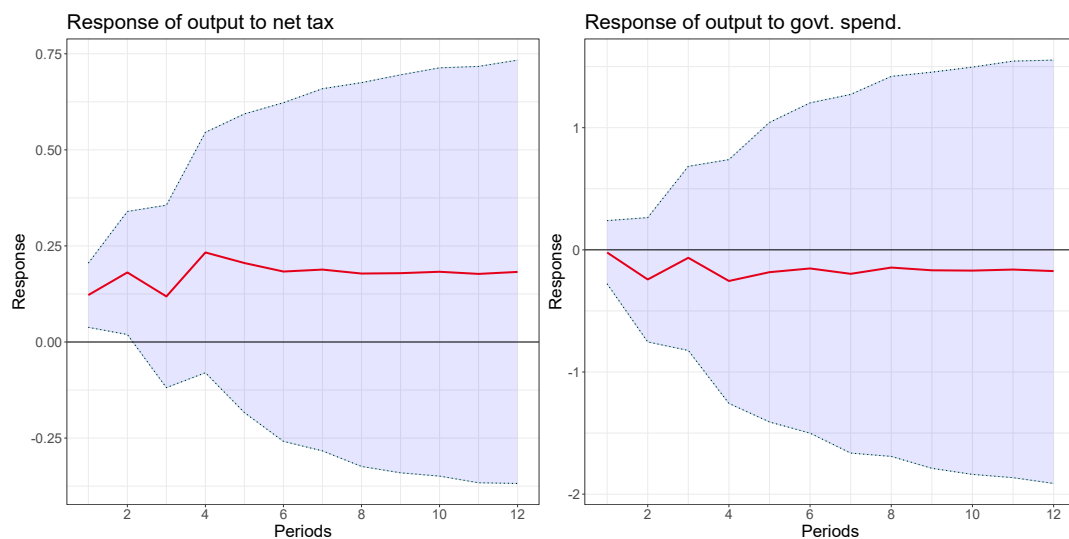


FIGURE 3.2: Cumulative impulse responses to unexpected expansionary fiscal policy: main specification

Shaded area represents 68 per cent credible set; red line is posterior median; both responses are normalised by their average ratio to GDP over the sample period.

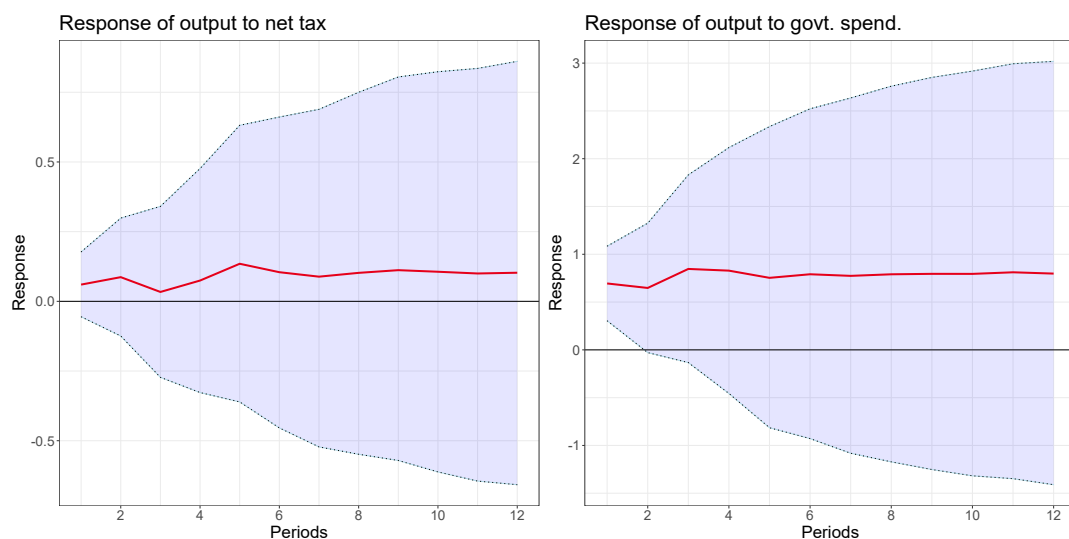


FIGURE 3.3: Cumulative impulse responses to unexpected expansionary fiscal policy: 1982-2010

Shaded area represents 68 per cent credible set; red line is posterior median; both responses are normalised to their average ratio to GDP over the sample period.

3.3.2 Estimates of uncertainty

Figure 3.4 plots our estimates of the net tax and government spending uncertainty from our preferred (stochastic trend) specification. The figure also contains two dashed lines for when the Public Finance and Fiscal Responsibility Acts were respectively passed by parliament; the pink-shaded areas are recession dates from Hall and McDermott (2016).

Looking at Figure 3.4, we see government spending uncertainty increases through to the end of 1986. We attribute the increase in uncertainty mainly to the construction of the large energy sector capital investment projects (collectively called the ‘think big’ projects) in the early 1980s, which would have resulted in large, lumpy government investment outlays.¹⁴ Post 1986, government spending uncertainty declined as these construction projects wound down.

The next spike in government spending uncertainty post 1986 is 1990Q4. The Treasury’s 1990 *Briefing for the Incoming Minister*, issued in October 1990, warned ‘the major [economic] uncertainty centres on the fiscal outlook’ (p. 30) as the deficits were not deemed sustainable. Then in December of 1990, the government was forced to commit around 620 million dollars (around 0.9 per cent of nominal GDP) to bail out the Bank of New Zealand. Although this transfer did not directly impact government consumption and investment, this led to a further strain on public finances and an austere ‘mini budget’ in December 1990. Government spending uncertainty then falls and remains relatively stable through the 1990s before increasing after the election of a new left-leaning government in 1999; uncertainty then peaks in 2005 before declining again. In explaining this dynamic, it is of note that upon Labour’s election in 1999, there was the so-called ‘winter of discontent’ — a fall in business confidence caused by concerns the government would reverse previously implemented market-based policies. Standard and Poors voiced a popular concern that ‘the economy could weaken thanks to more regulation and spending, higher taxes and a return to interventionist policies’.¹⁵ The Labour government scaled back their spending plans and established their fiscal credibility. Indeed, the theme of the 2006 budget was ‘the fool who spends on the upturn will find himself broke on the downturn.’¹⁶

Looking at Figure 3.4, we see that net tax uncertainty is relatively high from 1983 to 1985. Easton (2020, p. 501, p. 530) describes the tax system in the early to mid 1980s, which was heavily dependent on numerous indirect taxes at this point, as ‘antiquated’, ‘inefficient’, ‘arbitrary’, ‘clumsy’ and prone to tax avoidance. The list of tax exemptions for farmers, for example, ran for many pages. Further, ‘people found loopholes in all these exemptions and incentives. Many business decisions were taken to reduce or avoid tax, not because they made business sense’.¹⁷ An example of the clumsy nature of the tax system was, rather than reduce a generous superannuation scheme (that was contributing to a budget deficit), the government in 1984 introduced a 25 per cent tax on other superannuitant income (Dalziel & Lattimore, 2001, p. 121).

¹⁴Wells (1987, p.291) notes these construction projects peaked in 1983/84 with the total investment expenditures being four per cent of GNE.

¹⁵Quote is from The Spinoff, June 7 2018, *Does Jacinda Ardern face a Helen Clark style winter of discontent?* available at: <https://thespinoff.co.nz/politics/07-06-2018/does-jacinda-ardern-face-a-helen-clark-style-winter-of-discontent> [accessed 8 February 2022].

¹⁶Pierard, L. *EDITORIAL: Economy no task for caretaker*, Hawkes Bay Today, May 19 2006 [accessed 8 February].

¹⁷<https://teara.govt.nz/en/taxes/page-6> [accessed 8 February 2022].

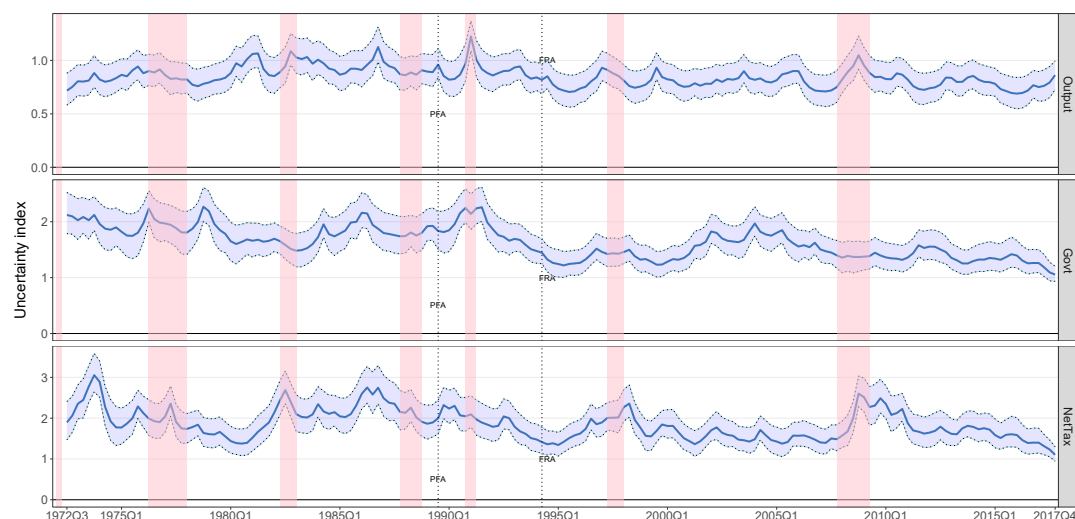


FIGURE 3.4: Estimated government spending and net tax uncertainty—main specification

Shaded area represents 68 per cent credible set; solid line is the posterior median

Net tax uncertainty spikes in 1986, the year in which there were a number of tax reforms.¹⁸ Measures were included to reduce tax evasion and tax avoidance; there were changes in the timing of provisional and terminal tax payments. Finally and most significantly, a collection of indirect taxes were replaced by a single consumption tax: Goods and Services Tax.

After the 1986 spike, the level of net tax uncertainty falls slightly. It then increases and remains elevated over 1989, 1990 and the first half of 1991. Goods and services tax, the consumption tax, was increased in 1989, but more significantly, 1990 saw what is termed the ‘fiscal crisis’ by Dalziel and Lattimore (2001, p. 67). The incoming government found policy in the previous Budget had not been fully costed and revenue had been inflated via an accounting loophole. The new Minister of Finance responded, primarily, by cutting welfare benefits (Dalziel & Lattimore, 2001, p. 68). Post the Fiscal Responsibility Act in 1994, tax policy uncertainty has stayed generally about the same level, albeit with spikes in 1997/98 (the Asian Financial Crisis) and 2008/09 (the Global Financial Crisis).

Figure 3.5 provides information to test the robustness of uncertainty estimates to alternative specifications of our model. Row one in figure 3.5 shows the results from the baseline specification discussed above. Row two is the uncertainty estimates from the specification where a deterministic rather than stochastic trend is assumed. Row three is the specification where a higher elasticity of tax to output is assumed. Specifically, we assume 3.13, the elasticity Popiel (2020) uses for his modelling in the United States and which was drawn, in turn, from Mertens and Ravn (2014). By way of background, Mertens and Ravn (2014), using a narrative identification approach, find that the output to tax elasticity of 2.08 proposed by Blanchard and Perotti (2002) for the U.S., based on institutional information on the tax system, is biased downwards. The value of 1.2 we adopt, taken from Hamer-Adams and Wong

¹⁸The following list draws on the Reserve Bank of New Zealand’s New Zealand economic and financial chronology 2014 - 1982; and is available at: <https://www.rbnz.govt.nz/about-us/nz-economic-and-financial-chronology> [accessed 8 February 2022]

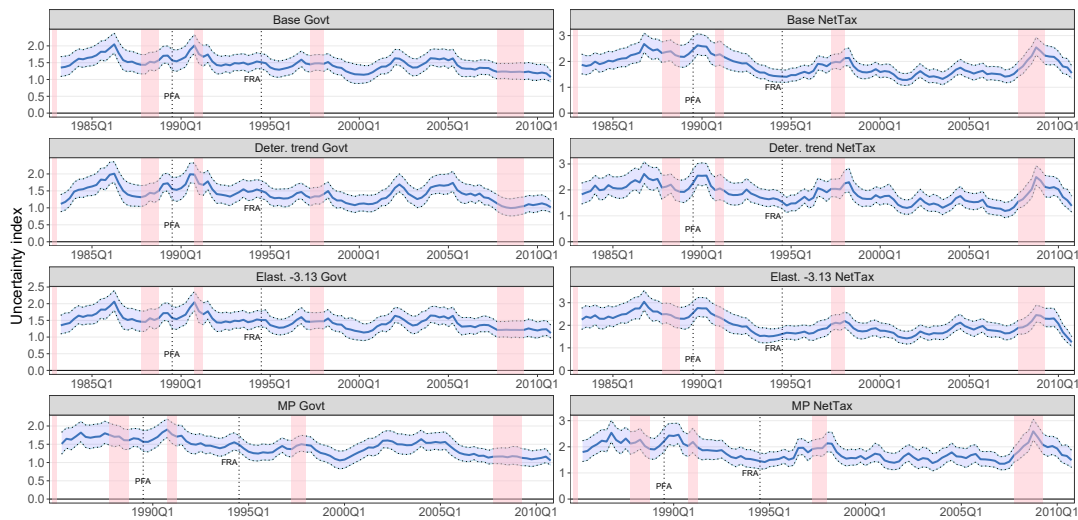


FIGURE 3.5: Estimates of government spending and net tax uncertainty from various specifications

*Shaded area represents 68 per cent credible set; solid blue line is the posterior median. **Base** refers to our baseline specification; **Deter. trend** refers to our specification with the deterministic trend; **Elast -3.13** refers to our specification with tax to output elasticity of 3.13 assumed; **MP** refers to our specification with 90 day interest rates added to the model; **Govt** and **NetTax** refers to uncertainty about government spending and net tax respectively.*

(2018), is similarly based on the institutional features of the New Zealand tax system. It is, therefore, plausible that our number, 1.2, is also biased downward.¹⁹ Row four is the uncertainty estimates from a specification where the nominal 90 day bill rate is included (and ordered last, as per Popiel, 2020) to control for monetary policy.²⁰ As Popiel (2020, p. 15) notes:

failing to control for monetary policy may attribute some of the fluctuations in output to fiscal policy when they are actually driven by actions taken by the Federal Reserve. Moreover, if important monetary policy events occur around times of large fluctuations in the volatility of government spending or revenue, then the same could be true for the effects of fiscal policy uncertainty

Looking down the first column of figure 3.5, it seems that the specification makes no significant difference to the estimates of net tax or government spending uncertainty. Table 3.4 confirms this: the correlation between the estimate from each alternative specification and estimate from the baseline specification is 0.87 or above.

3.3.3 Should we be concerned about fiscal policy uncertainty?

Before we turn to see if the two pieces of legislation lowered fiscal policy uncertainty, it is worth seeing if fiscal policy uncertainty is detrimental to the economy. The

¹⁹Indeed Parkyn and Vehbi (2014) find when they use a larger elasticity they get more sensible results in terms of the response of output to unexpected tax changes and suggest research is needed into the elasticity. We also get more sensible results when we use a larger output-to-tax elasticity (see figure 3.8 in the appendix).

²⁰Both Dungey and Fry (2009) and Power and Haug (2021) use the 90 day rate to reflect the stance of New Zealand's monetary policy.

	Govt spending uncertainty	Net Tax uncertainty
Baseline model	1	1
Deterministic trend model	0.96	0.94
Model with higher output/tax elasticity	0.997	0.94
Model with 90 day rate added	0.87	0.97

TABLE 3.4: Correlation between uncertainty estimates from alternative specifications and the uncertainty estimate from the baseline specification

legislation can only be seen as successful if it has reduced something that would have otherwise led to negative outcomes.

The specification of Popiel (2020) allows us to estimate the effect of the two types of fiscal uncertainty on output. The associated impulse responses are plotted in figure 3.6. We see that net tax uncertainty lowers output growth, but government spending uncertainty does not. Figure 3.7 shows this result holds in all specifications (i.e. alternative trend assumptions and alternative tax-output elasticities, relaxing the assumption that net tax uncertainty only affects output contemporaneously and the addition of the 90 day rate). The exception to this is, if the model is estimated from 1992Q3-2010Q4 with 1982Q2-1992Q2 used as the training sample (see the top left graph in figure 3.7).²¹ Popiel (2020) finds in his baseline specification (which is the same as our baseline specification) that, as we do, output falls in response to revenue (net tax) uncertainty but not government spending uncertainty. However, this effect disappears in the alternative specifications of Popiel (2020) once monetary policy is controlled for via adding the short-term interest rate. We do not observe this in our full sample: net tax uncertainty remains significant in all our specifications. Our results are in line with Fernández-Villaverde et al. (2015) who find capital tax uncertainty reduces output.²² We also concur with Mumtaz and Surico (2018) who find that net tax/revenue uncertainty decreases output, whereas government spending uncertainty does not. On the other hand, Born and Pfeifer (2014) find, using a DSGE model, that policy risk (which includes fiscal policy risk) has only small effects on output.

Why might net tax uncertainty be more detrimental to output growth than government spending? Nearly all firms and households need to pay tax, thus uncertainty around tax is likely to figure in the investment and saving decisions of nearly all firms and households. Further, households that rely on transfer payments are likely to be credit constrained and therefore will find borrowing difficult if transfer payments fall. Thus, an increase in uncertainty about transfer payments will lead to falls in consumption and output. Government spending uncertainty, on the other hand, is likely to be more significant for the smaller group of firms/organisations,

²¹We relax the assumption that net tax uncertainty only affects output contemporaneously by augmenting equation 3.7 with a lag of the tax uncertainty term. The resulting impulse response shows an impact on output owing to net tax uncertainty that is only marginally smaller than in the baseline specification. Hence we omit it from figure 3.7.

²²Fernández-Villaverde et al. (2015) assume a fiscal rule and estimate a model based on this rule. The volatility in the model's errors is assumed to be capital tax uncertainty. This estimate of capital tax uncertainty is then added to a SVAR. The SVAR is then used to measure the effect of capital tax uncertainty on output.

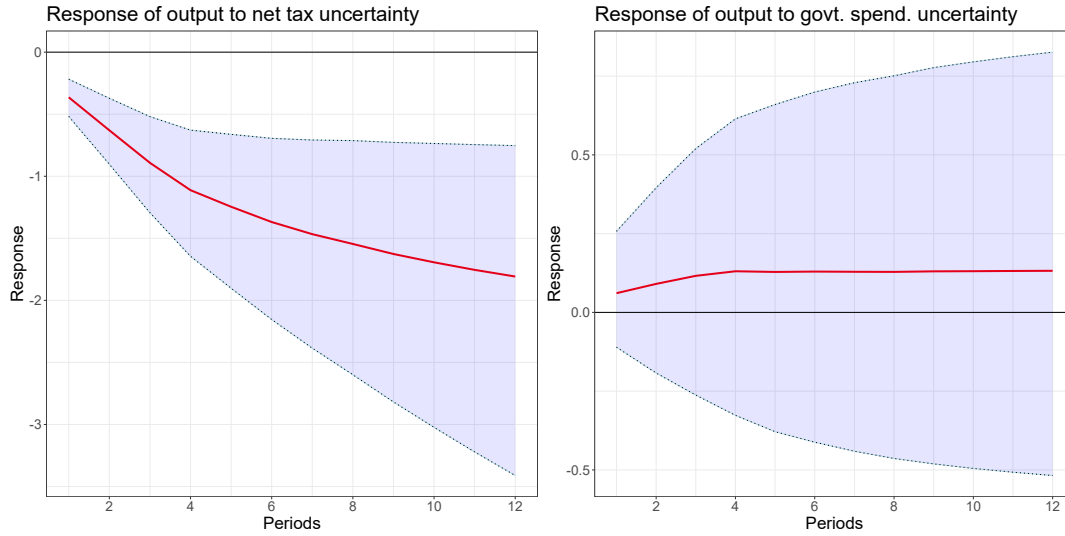


FIGURE 3.6: Response of output to fiscal uncertainty

Shaded area represents 68 per cent credible set; red line is posterior median, y-axis is in per cent growth rates

and their employees, that rely on the government to purchase their output. Examples of such organisations are those involved in infrastructure construction, government departments (those who provide consulting services to government departments) and those that supply goods and services to the defence forces.

3.3.4 Were the Public Finance Act and Fiscal Responsibility Act successful in reducing uncertainty?

To test if net tax or government spending uncertainty fell post the assent of the two pieces of legislation, we estimate the following regression:

$$Uncertainty_t = \beta_1 + \beta_2 During_t + \beta_3 Post_t + \beta_4 X_t + \epsilon_t \quad (3.10)$$

where $Uncertainty_t$ is either net tax or government spending uncertainty depending on the specification. $During_t$ is a dummy variable that takes a value of one between 1989Q3 (the Public Finance Act came into force on 1 July 1989) and 1994Q2 (the Fiscal Responsibility Act came into force on 1 July 1994) and zero otherwise. It controls for the fact that one piece of legalisation was in place in that period but not the other. Further, it also controls for the fact, as Janssen (2001, p. 29) notes: "the [Fiscal Responsibility] Act also codified a number of developments that had evolved in previous years." $Post_t$ is a dummy variable that takes a value of one post 1994Q2 and zero otherwise. This is our variable of interest. If the two pieces of legalisation have been successful in reducing uncertainty, we would expect the coefficient estimate on this variable to be negative and statistically significant.

Equation 3.10 also contains the term X_t . This variable takes a different form in different specifications of equation 3.10. It is omitted in the first specification; in specification (2) we use the policy uncertainty index from Baker et al. (2016) and in specification (3) we use the equivalent U.S. uncertainty index from Popiel (2020).²³ The Baker et al. (2016) index and the dependent variable equivalent U.S. index from

²³So if the dependent variable in equation 3.10 is net tax (government spending) uncertainty, we use the net tax (government spending) uncertainty variable for the United States from Popiel (2020).

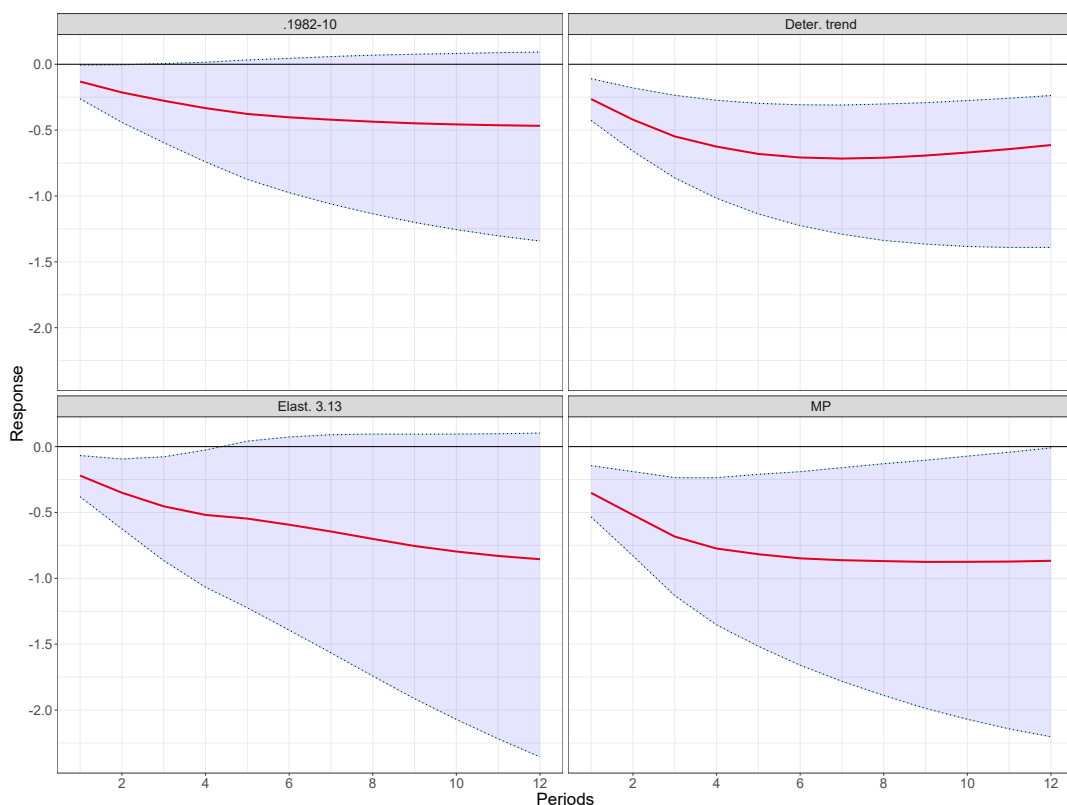


FIGURE 3.7: Response of output to net tax uncertainty: alternative specifications

Shaded area represents 68 per cent credible set; red line is posterior median, *y*-axis is in per cent growth rates.

Base refers to our baseline specification; *Deter. trend* refers to our specification with deterministic trend; *Elast -3.13* refers to our specification with tax to output elasticity of 3.13 assumed; *MP* refers to our specification 90 day interest rate added to the model; *Govt* and *NetTax* refers to uncertainty about government spending and net tax respectively.

Popiel (2020) are used to control for the effect of the so-called worldwide great moderation on uncertainty in New Zealand. The decline in volatility/uncertainty overseas will have spilt over into New Zealand via a number of different channels, particularly through export and import demand and prices, and financial markets. This, in turn, might have decreased uncertainty about fiscal variables. In specification (4), we use the lag of the output gap as the term X_t in equation 3.10.²⁴ We see value in controlling for the output gap given, one, uncertainty increases during recessions (Bloom, 2014, p. 153) and, two, New Zealand recessions have their genesis in overseas developments (Reddell & Sleeman, 2008). Thus we control the output gap to ensure that it is not just a high prevalence of recessions in our pre-legislation-implementation period that is driving higher uncertainty in that period (if that is what we observe).

Table 3.5 reports the results for revenue/net tax uncertainty. We estimate that in the period post the assent of both pieces of legislation, net tax uncertainty fell

²⁴This is created by applying the filter of Kamber et al. (2018) to the GDP series of Hall and McDermott (2011).

between around 0.5 standard deviations. These estimates are all significant at a one per cent level. Table 3.6 reports the results for government spending uncertainty. We estimate that in the period post the assent of the legislation, government spending uncertainty fell 0.25-0.34 standard deviations. These estimates are also all significant at a one per cent level.²⁵

TABLE 3.5: Net tax uncertainty: tests of the 'Post' variable

	Specification:			
	Point			
	(1)	(2)	(3)	(4)
During	-0.182 (0.159)	-0.189 (0.159)	-0.202 (0.163)	-0.267** (0.126)
Post	-0.508*** (0.093)	-0.509*** (0.091)	-0.518*** (0.091)	-0.527*** (0.083)
BBD		0.001 (0.002)		
U.S. net tax uncertainty			-0.073 (0.073)	
Lag of output gap				-0.109*** (0.024)
Constant	2.186*** (0.073)	1.992*** (0.240)	2.307*** (0.131)	2.224*** (0.068)
Observations	111	111	111	110
R ²	0.359	0.373	0.373	0.542
Adjusted R ²	0.347	0.355	0.356	0.529
Residual Std. Error	0.295 (df = 108)	0.293 (df = 107)	0.293 (df = 107)	0.252 (df = 106)
F Statistic	30.266*** (df = 2; 108)	21.201*** (df = 3; 107)	21.230*** (df = 3; 107)	41.771*** (df = 3; 106)

Note: HAC standard errors reported

*p<0.1; **p<0.05; ***p<0.01

Many economic reforms took place in the New Zealand economy from mid-1984 (see chapter 2). It is therefore important to rule out that it is not just reform-induced uncertainty that is driving our findings of higher fiscal uncertainty prior to the legislation being enacted. Appendix two reports our results if we re-estimate our model on a sample spanning the quarters 1961Q2 to 2010Q4; this generates fiscal uncertainty estimates for the quarters 1972Q2 to 2010Q4 once lags and burnin quarters are allowed for. The construction of this backdated series uses data from various historical sources; these sources are discussed in Appendix two. It is important to note, that these series use actual quarterly values and is, in the main, not interpolated using annual totals for the 1972Q2 to 1982Q1 period like the data in the baseline model (see table 3.1). We were only able to source these historical series late in the piece and hence we have used them as part of a robustness test. In a revised version of the paper, this backdated series will play a more prominent role in the analysis: they will be used as the main series.

Having generated new, longer fiscal uncertainty series, we then re-estimate equation 3.10 twice, once with government spending and net tax uncertainty as the dependent variable (but with no other covariates). For both dependent variables, the coefficient estimate for the 'Post' variable is still negative and statistically significant. Indeed, the coefficient estimates for the 'Post' variable are more negative in this longer sample. This suggests fiscal policy was deemed to be more uncertain in the 1976 to 1981 period than in 1982 to 1989 period. This is consistent with Wells

²⁵We use HAC standard errors to assess statistical significance. We do this as we detected both heteroskedasticity and autocorrelation, via the Breusch-Pagan and Breusch-Godfrey tests respectively, in our models.

(1987, p. 286) who notes the constantly shifting focus of fiscal policy in the 1976 to 1984 period, before fiscal policy settled on one dominant objective post the 1984 election: resource allocation (Wells, 1987, p. 291).

To further test the robustness of our results, we conduct a Placebo-type test (see Cunningham, 2021, p. 284). Specifically, we re-run specification one of equation 3.10 twice, once with each of the U.S. uncertainty measures of Popiel (2020) as the dependent variable. Recall that we found the coefficient estimate for the 'Post' variable was negative and statistically significant in all the regressions when the New Zealand uncertainty variables were the dependent variables. If it really is New Zealand's fiscal legislation driving this result, we would not expect negative and statistically significant coefficient estimates on the 'Post' variable when the U.S. government spending and net tax uncertainty estimates of Popiel (2020) are used as the dependent variable. If the coefficient estimate on the 'Post' variable is still negative and significant, it suggests that rather than the legislation, it might be the worldwide great moderation that lowered New Zealand uncertainty. Table 3.7 reports the results of running the aforementioned regression. We see that the coefficient estimate on the 'Post' variable is not statistically significant in the equation when U.S. net tax uncertainty is the dependent variable. It is, however, statistically significant in the equation when U.S. government spending uncertainty is the dependent variable, with a coefficient estimate of -0.15. This result cautions against interpreting the observed fall in government spending uncertainty, reported in table 3.6, as being due to the Public Finance and Fiscal Responsibility Acts.

TABLE 3.6: Government spending uncertainty: tests of the 'Post' variable

	Specification:			
	Point			
	(1)	(2)	(3)	(4)
During	-0.031 (0.077)	-0.029 (0.079)	-0.104 (0.092)	-0.030 (0.080)
Post	-0.247*** (0.061)	-0.247*** (0.062)	-0.337*** (0.083)	-0.257*** (0.059)
BBD		-0.0005 (0.001)		
U.S. govt spending uncertainty			-0.622** (0.296)	
Log of output gap				0.019 (0.012)
Constant	1.613*** (0.054)	1.682*** (0.088)	2.193*** (0.295)	1.619*** (0.052)
Observations	111	111	111	110
R ²	0.357	0.363	0.404	0.391
Adjusted R ²	0.345	0.346	0.387	0.373
Residual Std. Error	0.156 (df = 108)	0.156 (df = 107)	0.151 (df = 107)	0.153 (df = 106)
F Statistic	29.993*** (df = 2; 108)	20.358*** (df = 3; 107)	24.139*** (df = 3; 107)	22.645*** (df = 3; 106)

Note: HAC standard errors reported

*p<0.1; **p<0.05; ***p<0.01

TABLE 3.7: Results if U.S. uncertainty measures are used as dependent variable

	<i>Dependent variable:</i>	
	U.S. Net tax uncertainty	U.S. Govt Spend uncertainty
	(1)	(2)
During	−0.279 (0.174)	−0.116*** (0.030)
Post	−0.126 (0.186)	−0.145*** (0.032)
Constant	1.648*** (0.124)	0.932*** (0.029)
Observations	111	111
R ²	0.022	0.439
Adjusted R ²	0.004	0.428
Residual Std. Error (df = 108)	0.595	0.068
F Statistic (df = 2; 108)	1.225	42.229***

Note: Standard errors are HAC

*p<0.1; **p<0.05; ***p<0.01

3.4 Conclusion

Drawing on the paper of North (1991a), we argued in this paper that uncertainty is a key metric in assessing the reform of institutions. From 1984-95, New Zealand undertook a wide-ranging reform of its institutions. One component of this reform was the development of two much-lauded, and copied, pieces of legislation guiding fiscal management and policy: the Public Finance Act (1989) and the Fiscal Responsibility Act (1994).

This paper evaluated if the aforementioned legislation were successful in reducing revenue and government spending uncertainty. Our results suggest that the legislation most probably reduced net tax uncertainty. However, we are less certain about government spending uncertainty, as one of our robustness tests suggest the fall in government net tax uncertainty could reflect the worldwide great moderation. The fact we can be more certain that the Public Finance Act and Fiscal Responsibility Act reduced net tax uncertainty is a positive given another finding of this paper is that net tax uncertainty is more detrimental to output growth than government spending uncertainty. Reflecting on our finding that these pieces of legislation reduced fiscal uncertainty, it is interesting that an institution that is enforced more by political commitments than legal means is so effective.

Two pieces of further research come to mind. Firstly, given the legislation also refers to the prudent management of public debt, it would be informative to look at government debt uncertainty when evaluating the legislation's success; Mumtaz and Surico (2018) provide a framework for estimating such uncertainty. Secondly, our measure of uncertainty is based on one-step-ahead forecast errors. It would be worth using alternative measures of fiscal policy uncertainty—for example, the newspaper text-based measures of Baker et al. (2016)—to see if the results change. This will be achievable once more of New Zealand's historical newspapers are digitised.

3.5 Appendix 1

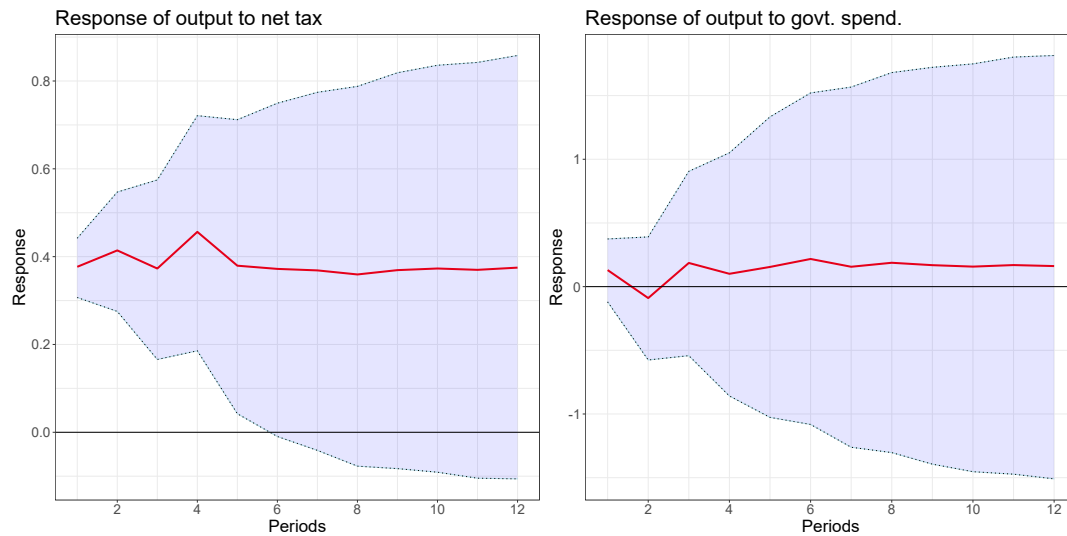


FIGURE 3.8: Cumulative impulse responses to unexpected expansionary fiscal policy: Higher output/tax elasticity of 3.13

Shaded area represents 68 per cent credible set

3.6 Appendix 2: Uncertainty estimates from a longer sample

In the main text we generate fiscal uncertainty estimates for the period 1983Q2 to 2010Q4. This means 1983Q2 to 1989Q2 is the period over which we measure pre-legislative reform uncertainty. It could be the uncertainty associated with the broader economic reform period, which began in 1984Q3, is driving our result of heightened fiscal uncertainty prior to the change in fiscal policy legislation. In order to rule this out (or not), we have attempted to extend our sample period back to 1961Q2.

In terms of extending our data series backwards, for the real (volume) government consumption series, the real government investment series and the GDP deflator series, from 1961Q2 to 1979Q1, we use the corresponding series of Grindell (1981). The challenge is then how to estimate the missing data from 1979Q2 to 1982Q1 when the Dungey and Fry (2009) data set begins. We interpolate the real government consumption series using the quarterly growth rates in the volume of general government consumption from the OECD Quarterly National Accounts.²⁶ The government investment series and GDP deflator series are interpolated using the Chow-Lin procedure as described in the main text (that is, using annual data from either (Dalziel & Lattimore, 2001) or Data1850, in conjunction with various quarterly indicator variables).

In terms of extending our tax series backwards, we have quarterly government revenue data from Buckle and Snively (1979), which is available from 1960Q1 to 1979Q2. This revenue data is revenue from taxation, as well as revenue from the government's trading activities; the latter is very small relative to the former, however. Using the annual totals of taxation revenue from the Treasury's historical fiscal

²⁶Available here: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA> [variable code: VPVO-BARSA]

indicators dataset, we scale the revenue series to ensure our quarterly series sum to the Treasury's reported annual tax totals.²⁷ Again we interpolate the missing data between 1979Q2 and 1982Q1 using the Chow-Lin procedure as described in the main text. Transfer outlays are interpolated as per the method described in the main text (that is, using annual data from either (Dalziel & Lattimore, 2001) or Data1850, in conjunction with various quarterly indicator variables).

We then re-estimate our baseline model on our longer sample: 1961Q2 to 2010Q4. Again we use the first 40 quarters as burnin observations, so we get government spending and net tax uncertainty estimates for 1972Q2 to 2010Q4 (as four observations are also lost owing to variables entering the VAR with up to four lags). Figure 3.9 reports our uncertainty estimates from longer sample. The key point is the government spending and net tax uncertainty observed using the broad economic reform period (1984Q3 to 1995Q4) is similar to, or in the case of government spending lower than, our estimates of uncertainty for the period 1972Q3 to 1984Q2.

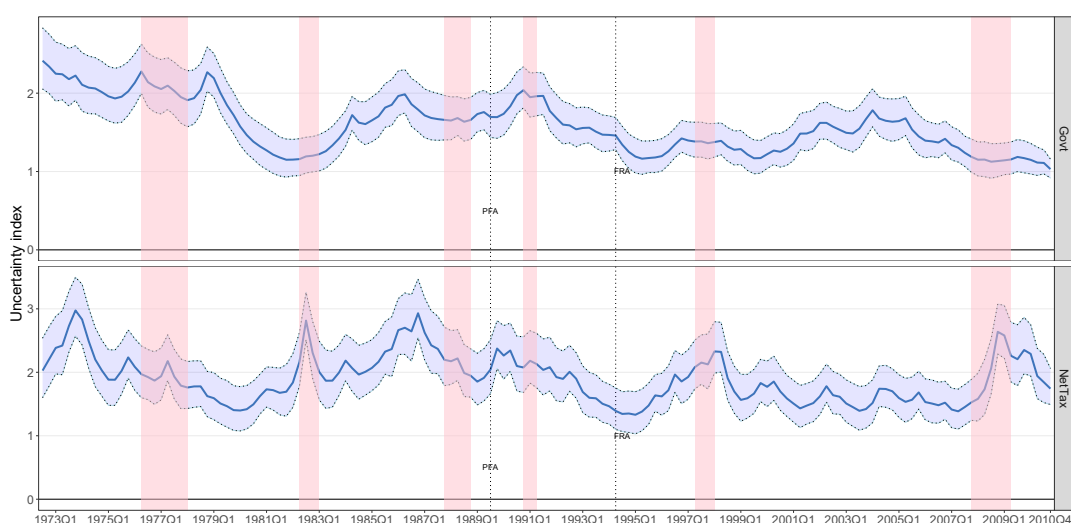


FIGURE 3.9: Estimated government spending and net tax uncertainty—main specification with longer sample

The shaded area represents 68 per cent credible set; the solid line is posterior median

We then re-estimate equation 3.10 on the longer sample of fiscal uncertainty estimates to see if the 'Post' variable is still significant. We re-estimate the simplest specification of equation 3.10 i.e., no additional co-variables such as the output gap etc. Table 3.8 reports the results. Columns (1) and (2) report the results if we dummy out the quarters 1979Q2 to 1982Q1 as these are the quarters where we interpolate many of our fiscal series; columns (2) and (3) report the results if we do not dummy these quarters out. The evidence in table 3.8 suggests that estimating our model on a longer sample does not change the key results reported in tables 3.6 and 3.5 in the main text: post the assent of the legislation, government spending and net tax uncertainty fell and the estimated fall is significant at a one per cent level.

As noted in the main text, the results contained in this appendix will be given more prominence in a revised version of the paper. The reason they are relegated

²⁷<https://www.treasury.govt.nz/publications/information-release/data-fiscal-time-series-historical-fiscal-indicators> [accessed 16 April 2022]; for revenue data before 1972 we assume the 1972 ratio holds.

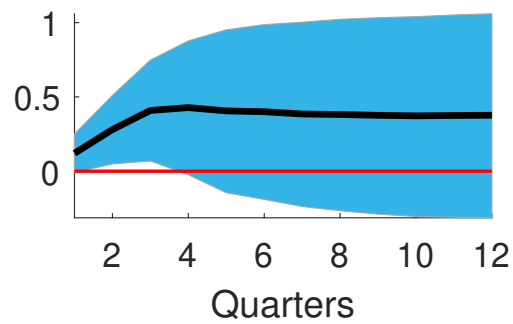
TABLE 3.8: Tests of the significance of the 'Post' variable—sample: 1972Q2-2010Q4

	<i>Dependent variable:</i>			
	NetTax (1)	Govt (2)	NetTax (3)	Govt (4)
During	−0.998* (0.558)	−0.586 (0.384)	−0.595 (0.562)	−0.344 (0.384)
Post	−1.714*** (0.436)	−1.671*** (0.299)	−1.310*** (0.444)	−1.429*** (0.300)
Chow-Lin	−2.286*** (0.400)	−1.370*** (0.456)		
Constant	4.806*** (0.349)	3.520*** (0.275)	4.402*** (0.360)	3.278*** (0.276)
Observations	154	154	154	154
R ²	0.307	0.467	0.162	0.369
Adjusted R ²	0.293	0.456	0.151	0.361
Residual Std. Error	1.282 (df = 150)	0.825 (df = 150)	1.405 (df = 151)	0.893 (df = 151)
F Statistic	22.156***	43.725***	14.579***	44.242***

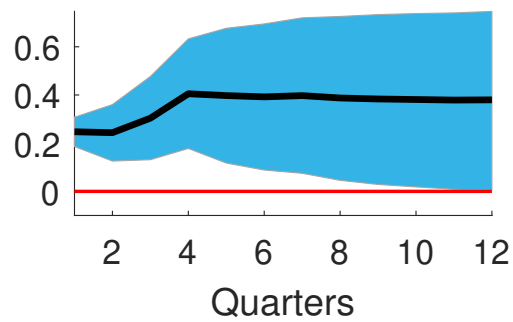
Note: Standard errors are HAC

*p<0.1; **p<0.05; ***p<0.01

to an appendix currently is we only tracked down much of the historical data late in the piece. Figure 3.10 shows the reason they will be given more prominence. The impulse responses generated using the alternative backdated series are more sensible—in that both an increase in government spending and a tax cut increase output (and the effect size is larger and more in line with expectations)—than those generated when interpolated data is used in the burn-in sample; this indicates our hunch in footnote 11—that interpolation was causing an issue—was correct.



(A) Cumulative impulse responses to unexpected expansionary government spending shock



(B) Cumulative impulse responses to unexpected expansionary tax shock

FIGURE 3.10: Cumulative impulse responses to unexpected expansionary fiscal policy: longer series

Chapter 4

Uncertainty and monetary regimes: a reassessment

Abstract

This paper provides new evidence on two old questions. The first is, which historical monetary regime was associated with the lowest level of uncertainty? The second is, are specific types of uncertainty more prevalent in some monetary regimes than others? Our innovation in answering these questions is, rather than focusing on the volatility in numerical data as others have, the use of text data. We argue text data more readily captures the subjective nature of uncertainty. Using a Structural topic modelling algorithm, a machine learning technique for text data, we analyse over 10,000 United States and United Kingdom newspaper articles from the period 1890 to 2014. We find the Bretton Woods regime was associated with the lowest level of uncertainty overall. Further, we find, in general, the prevalence of specific types of uncertainty tends to be differ across regimes, particularly post World War 2.

4.1 Introduction

4.1.1 Our research questions

‘Bringing back the gold standard would be very hard to do, but, boy, would it be wonderful. We’d have a standard on which to base our money.’ so said Donald Trump, former President of the United States.¹ The past naturally evokes nostalgia. However, just as the assessment of a particular, but not accurately, remembered event in one’s own life can be changed by the accounts of others who recall the event more accurately, so too, we argue, can the assessment of the merits of a particular monetary regime. For this task, the accounts we use encompass over 10,000 newspaper articles from prominent publications: *The New York Times*, *the LA Times*, *The Guardian and Observer*, *the Times*, *The Wall Street Journal* and *the Economist*. The authors of these newspaper articles recall the regimes more accurately because they lived through them.

This paper uses the tools of modern text mining on historical newspaper articles to understand the association of particular types of uncertainty with particular historical monetary regimes; that is, it studies if some types of uncertainty are more prevalent in some regimes than in others. This paper addresses two research questions specifically: (1) Which monetary regime had the overall lowest level of

¹Trump Favors Returning To The Gold Standard, Few Economists Agree; available at: <https://www.npr.org/2016/06/16/482279689/trump-favors-returning-to-the-gold-standard-few-economists-agree> [accessed 23/11/21].

uncertainty associated with it? (2) And are certain monetary regimes associated with lower levels of specific types of uncertainty? Either one or both of these research questions have been studied before by several eminent economists: Meltzer (1986); Bordo and Schwartz (1999); Benati and Goodhart (2010). So why bother? We take these questions up again as research questions for two reasons. The first reason is that the papers of Meltzer (1986) and Bordo and Schwartz (1999) do not consider inflation targeting as a regime, while Benati and Goodhart (2010) only consider regimes post Bretton Woods. We study all the regimes from 1890 to the present day (well, 2014). The second reason is technological advances allow for a new take on the questions. Specifically, the development of text mining and natural language processing techniques, along with the digitisation of historical newspapers, allows us to answer these questions using different data. The aforementioned papers rely on numerical data to construct volatility-based measures. Volatility-based measures of uncertainty have their place but may miss the subjective nature of uncertainty. Newspaper text captures the real-time discourse on uncertainty. Inasmuch as newspaper articles reflect peoples' different subjective attempts (as reflected by different journalists' writings) to interpret the economic events of the time (and their implications for the future), the discourse in newspaper articles is ideal for capturing the matters of which contemporary observers felt uncertain about. And, it is, after all, the contemporary assessment of uncertainty, rather than the retrospective assessment, that drives behaviour.

The second advantage of textual data is that it allows researchers to study the prevalence of types of uncertainty that are not amenable to measurement in numerical data. For example, uncertainty relating to the political tensions around monetary regimes—such as the bimetallism (circa. 1896-1900) or the return to gold standard debates (mid-1930s) in the United States—are not easily captured by macroeconomic or financial data.

The paper, therefore, offers two contributions. It reexamines the question of which monetary regimes had the highest and lowest levels of uncertainty using an alternative data source than typically used. Secondly, it establishes that the types of uncertainty associated with monetary regimes are generally idiosyncratic to that particular regime.

4.1.2 Motivation

To motivate both our research questions with theory we draw on two strands of literature: the Mundell-Flemming model and the literature on institutions. We begin with the Mundell-Flemming model (Fleming, 1962; Mundell, 1963), the major implication of which is the so-called 'impossible trinity' or 'trilemma'. The 'trilemma' is an open economy cannot simultaneously achieve the following three objectives:

- free movement of capital;
- independent (autonomous) monetary policy; and
- fixed (managed) exchange rates.

Only two out of the three are possible. A quick glance at modern economic history, shows that governments have made different choices at different times about which of the above objectives is dropped. Indeed, even at the same point in history different governments have adopted heterogeneous positions about which of the objectives

they are willing to not achieve.² Today, many developed countries focus on free movement of capital and independent monetary policy (at the expense of a fixed exchange rate), although there are some countries that fix exchange rates but control the flow of capital (e.g. China) or give up autonomous monetary policy to achieve a fixed exchange rate and free capital flows (e.g. countries in the Euro zone).

North (1991a, p. 97) defined institutions as the ‘humanly devised constraints that structure political, economic and social interaction’. The specific objective the government drops in order to reconcile the trilemma will result in a specific set of constraints on agents in the economy; that is, it will result in a particular institutional structure. Dropping autonomous monetary policy constrains the ability of governments and central banks to respond to unemployment or inflation; limiting capital flows constrains the way current account deficits can be financed to official borrowing or the sale of foreign exchange reserves. North (1991a, Abstract) goes on to argue institutions ‘have been devised by human beings to create order and reduce uncertainty in exchange’. We argue *different types* of institutions reduce *different types* of uncertainty (and result in an increase in other types of uncertainty). And, thus, in our specific application—different monetary regimes through history—our hypothesis is different regimes should result in different prevalence of particular types of uncertainty. A simplistic example might help to concretise our idea. A *credible* fixed exchange rate monetary regime which is absent autonomous monetary policy (that is, a regime where the exchange rate is the nominal anchor), will lower exchange rate uncertainty, but uncertainty about the price level may be high; in contrast, a *credible* monetary regime where autonomous monetary policy is targeted towards domestic policy objectives, such as unemployment or inflation (or both) but the exchange rate is floating, might lower inflation and unemployment uncertainty but uncertainty about the exchange rate level might be higher.

The above examples used the adjective ‘credible’ in describing the regimes. The perception of the regime’s credibility will have implications for the types of uncertainty observed. If financial markets do not view a fixed exchange rate regime as credible (in that the government might abandon it at some point to achieve another objective), exchange rate uncertainty might be very high under such a fixed exchange rate regime. A regime’s credibility reflects a number of factors, including the nation’s previous record in preserving regimes, as well as if the specific rule is right given the economy’s fundamentals—the value an exchange rate is fixed at might be perceived to be too high given the current account deficit, for example.

4.1.3 Defining monetary regimes

Bordo and Schwartz (1999) define a monetary regime as the ‘constraints or limits imposed by custom, institutions and nature on the ability of the monetary authorities to influence the evolution of macroeconomic aggregates’ (p. 1).³ McKinnon (1993, p. 1) (quoting Mundell, 1972) defines monetary orders as the: ‘framework of laws, conventions, regulations, and mores that establish the setting of the system and the understanding of the environment by the participants in it.’ McKinnon (1993, p. 1) then goes on to say ‘[m]ore informally, an international monetary order is often called “the rules of the game”’. To us, McKinnon (1993, p. 1) is describing an institutional framework; indeed in the literature on institutions, institutions are often called

² Although, as Monnet (2018, p. 350) notes, the ‘trilemma should rather serve as an ideal type; that in practice there is almost no case in where policy is positioned at the corners because the choice between fixed and floating exchange rates is not dichotomous and capital controls are never fully binding’.

³ Bordo and Schwartz (1999) use ‘monetary regime’ and ‘monetary policy regime’ interchangeably.

the ‘rules of the game’ (North, 1991b, p. 477). Thus we see monetary order, monetary regime and monetary institutions as all referring to essentially the same thing: the formal and informal constraints (and the enforcement of these constraints) on agents in the economy relating to ‘exchange rate objectives, official reserve holdings, convertibility commitments, adjustments in domestic monetary policies, the choice of a ‘nominal anchor’ for the price level, and so on’ (McKinnon, 1993, p. 2). We adopt the term *monetary regime* for the sole reason it is the terminology used in the Meltzer (1986), Bordo and Schwartz (1999), and Benati and Goodhart (2010) papers.

4.1.4 The rest of the paper

The rest of the paper is structured as follows. Section 4.2 outlines some of the key features of the different monetary regimes since 1890, as well as some of the key events that the regimes had to cope with. Section 4.3 outlines our methodology for creating our dataset or, more correctly, our corpus of newspaper articles to study. Section 4.4 discusses the differences in the levels of uncertainty between regimes. Section 4.5 takes an initial look at how the different types of uncertainty varied between regimes using basic methods; sections 4.6 and 4.7 take another look at this using more sophisticated methods. Section 4.8 concludes.

4.2 An overview of monetary regimes through an institutional lens

This section provides a brief overview of the key monetary regimes since 1890.⁴ Our focus in the overview is on contrasting the similarities, and differences, between regimes with respect to monetary institutions, as well as mechanisms designed to enforce these institutions. By monetary institutions we mean the formal institutions (mainly ‘laws’ or ‘contracts’), the informal institutions (mainly ‘conventions’ or explicit or implicit cooperation agreements) that relate to exchange rate objectives, convertibility commitments, domestic monetary policies and the choice of a ‘nominal anchor’ for the price level. Given the newspapers in our corpus, we focus, in the main, on the particulars of monetary regimes in the United States and the United Kingdom.

Cognisant of the idea that the uncertainty associated with any particular monetary regime will change as circumstances change, we also outline some key events/developments from the point of view of monetary regimes since 1890.

4.2.1 The classical gold standard: 1870 to 1914

Peel’s Bill, or the 1819 Act for the Resumption of Cash Payment, formally put the United Kingdom on the gold standard in 1819, after a period of nearly one hundred years on a de facto gold standard. Analogously the Gold Standard Act formally put the United States on the gold standard in 1900, after effectively restoring the gold standard in 1879 (Eichengreen, 2019).⁵ These laws meant citizens could convert freely between domestic money and gold at the established price; in the United States, through the Coinage Act of 1834, this had been established at \$20.67

⁴Given the breadth of the topic, a detailed exposition would run into many pages as evidenced by the treatments of Friedman and Schwartz (1971) and Davies (2010), amongst others.

⁵This was the second time around for the United States, having first been on the gold standard in 1834, only to suspend it during the Civil War.

per ounce—where it remained until 1933.⁶ In order to maintain convertibility, different countries had different statutes around the gold reserve-currency relationship: the United Kingdom allowed a limited amount of currency to not be backed by gold, but beyond this limit currency had to be backed by gold one-for-one (Eichengreen, 2019, p. 21-22); other countries, such as the United States, operated a proportional system.

For the system to work as intended, there were also a number of conventions (commonly called the ‘rules of the game’; see Keynes, 1925 and McKinnon, 1993), that central banks needed to follow. Firstly, countries losing (gaining) gold as a result of the balance of payments deficit (surplus) were supposed to increase (decrease) their interest rates to decrease (increase) the domestic money supply; this rule was supposed to restore external balance via changes to the price level affecting the country’s external competitiveness (the so-called ‘price-specie flow mechanism’). Bernanke and James (1991, p. 37) notes deficit countries needed to comply with this rule to avoid excessive reserve loss; however, this rule was sometimes violated by surplus sterilising the increases in the money supply if it suited domestic objectives—this led to a deflationary bias in the gold standard (and the gold exchange standard). A second rule central banks followed was not restricting gold flows or exchange transactions on the current or capital accounts (McKinnon, 1993).

Additionally, there were a number of important conventions/customs (i.e. informal institutions) relating to the gold standard. Firstly, external balance concerns dominated domestic policy goals when the two came into conflict (Bordo, 2021); this custom meant capital flows moved in a stabilising direction (Eichengreen, 1992, p. 9) as traders believed misalignments in the exchange rate would be corrected—this minimised the need for intervention (Eichengreen, 2019, p. 39). A related custom was in times of crisis, international central banks/ governments cooperated to keep the system operating by offering each other assistance. In tranquil times, the Bank of England provided tacit leadership (Eichengreen, 1992, p. 9).⁷ Finally, there was a convention that the gold standard would be suspended during wars, so they could be financed by expanding the money supply, but countries would return to the gold standard afterwards at the same parity (McKinnon, 1993, p. 4, Rule box 1).

Eichengreen (2019, p. 39) notes trade benefited from, and supported, the gold standard. Trade benefited from stable exchange rates, while also providing a way via the price-specie flow mechanism to help countries maintain their par exchange rates. Trade was relatively free, although more restrictions were being placed on trade as the regime progressed—after 1873, domestic laws, in several countries, had been passed to put tariffs on goods. This meant, by 1901, Britain was the only major nation without tariffs (Roberts, 2004).⁸

Capital flowed across borders relatively freely prior to 1914 to where it could make a profit (Rauchway, 2008). Turner (1991) notes financial uncertainty was low in

⁶This paragraph draws heavily on Michael Bordo’s entry on The Gold Standard at Econlib: <https://www.econlib.org/library/Enc/GoldStandard.html> [accessed 29/11/21].

⁷Bordo (1995) notes that the Bank of England maintained the key international rule—the maintenance of gold convertibility at the established par value—via its discount rate. Flandreau (1997) disrupts central bank cooperation was significant, saying it was: ‘exceptional, never reciprocal, and always failed to institutionalize. The attitude of central banks towards each other was found to oscillate between hatred, neglect, and indifference. As a result, any attempt to build on cooperation a comprehensive interpretation of nineteenth-century monetary stability would not be convincing’ (p. 737).

⁸Germany was instrumental in challenging free trade, imposing tariffs on its trading partners at the turn of the 19th century (Clavin et al., 2021). Further, the dominions—New Zealand, Canada and Australia—all introduced preferential rates for Imperial products (Glickman, 1947).

the period reflecting, in part, the stability of gold standard currencies (especially the sterling). Stable currencies reduced uncertainty about the real values of debts/credits. Further, as noted above, capital flows stabilised currencies, reducing the need for intervention in markets to maintain par exchange rates. As with trade, capital flows benefited from, and supported, the gold standard.

The gold standard 'resolved the trilemma problem' by giving up autonomous monetary policy in exchange for exchange rate stability and free flows of capital. This created an issue. Worldwide, the pace of gold discovery in the late 1800s failed to keep up with the demand for gold to support economic activity; this imparted deflationary forces on the world, and monetary policy was unable to respond to this. This meant the concept of fixing domestic money solely to gold was challenged. Particular debtor groups in the United States, such as farmers, wanted inflation so their debts did not increase in real terms. This led to a campaign for a bimetallic standard; as we will see the debate was a source of considerable uncertainty.

4.2.2 The interwar period: 1919-39

The postwar period to the depression period has three distinct periods in terms of monetary regimes: 'general floating' (1919-25), gold-exchange standard (1926-31) and the managed float (1931-39) (Bordo & Schwartz, 1999).

World War 1 and the general floating period

The figure below shows the percentage of 18 advanced countries that have a floating exchange rate at given points in time. We see the percentage floating jumped from 17 per cent in 1913 to 89 per cent in 1915. The reason being, in order to fund the war, and with gold reserves inadequate, many countries reverted to fiat money. A high prevalence of countries with floating exchange rates persisted in the first half of the 1920s. Further, Eichengreen (2019, p. 43) notes a distinct feature of the period was the lack of central bank intervention in the foreign exchange market (a new *convention*); he concludes the 'first half of the 1920s thus provides a relatively clean example of a floating exchange rate regime' (p. 43). In terms of our countries of interest, the pound remained pegged to the U.S. dollar until 1919 when it floated, while the U.S. dollar remained fixed to the price of gold throughout the period.

A second development during the war was, in order to preserve gold, countries reverted to exchange and capital controls (Eichengreen, 1992). The capital mobility index of Obstfeld and Taylor (2004) fell from 0.81 before the war to 0.13 in 1918 and only recovered slightly over the decade (see table 4.1).⁹ Concerns about the adequacy of their gold reserve, as well as a desire to return to the gold standard at pre-war parity, saw the United Kingdom adopt a number of policies designed (in addition to raising the discount rate) to prevent gold outflows; these included restrictions on foreign currency purchases (Eichengreen, 1992, p. 101), restricting the right to export gold and giving the authorities the right to impound gold imports (Eichengreen, 1992, p. 71). Although Eichengreen (1992, p. 71) notes the United Kingdom was very moderate relative to other countries. Further, the UK removed many of the restrictions very quickly. In other developments post 1914, Bordo and Schenk (2021, p. 6) note '[f]ree trade turned into managed trade and tariffs were raised further. . . Moreover the balance of economic power shifted from the UK to the US as leading global creditor'.

⁹The capital mobility index data is taken from Reinhart and Rogoff (2009); see <https://carmenreinhardt.com/this-time-is-different/> fig. 10.1.

Year	Capital Mobility Index value
1880	0.38
1900	0.75
1914	0.81
1918	0.13
1925	0.25
1929	0.40
1945	0.06
1960	0.14
1971	0.19
1980	0.27
2000	0.88
2007	0.80

TABLE 4.1: Capital mobility index in selected years

Note: The Capital mobility index is bounded by zero (min) and one (max)

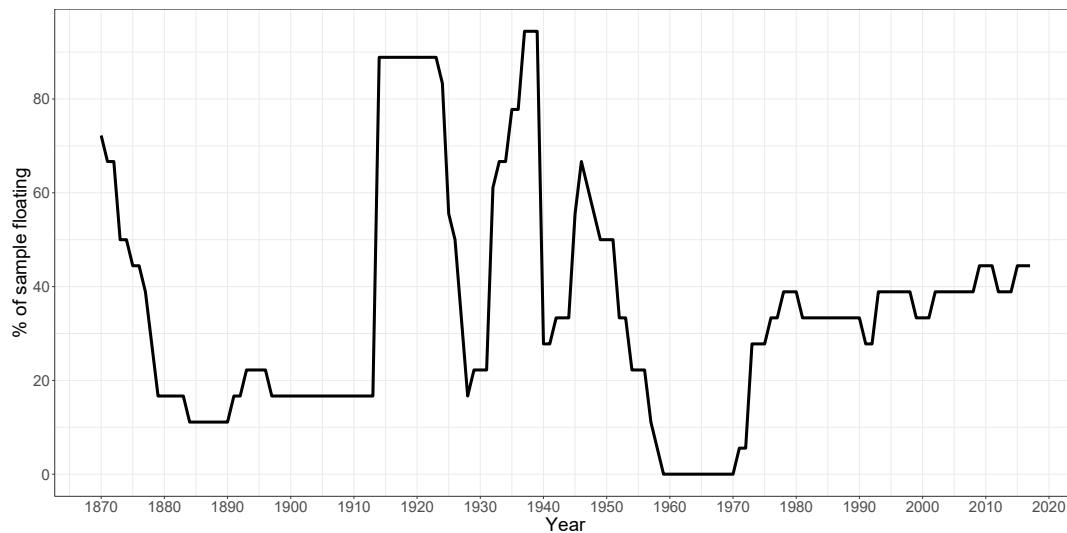


FIGURE 4.1: Percentage of 18 advanced countries floating at various points in time

Source: Jordà et al. (2017)

There was a marked change in the monetary institutions in the classical general floating regime (and the war years), compared with the classical gold standard regime. In terms of the trilemma, laws, customs and conventions facilitating fixed exchange rates and freely flowing capital were abandoned to persuade domestic policy objectives: maintaining adequate gold and money to finance the war and the subsequent rebuild (as well as paying reparations if required).

The gold exchange standard

It was not until the mid-1920s that the percentage of countries floating began to fall as the gold standard was reconstructed (see figure 4.1); this reconstruction began with the Brussels (1920) and Genoa (1922) conferences (Bordo, 2021) and reflected a desire to return to the perceived stability of the halcyon days of the gold standard. The United Kingdom returned to gold in 1925 (and as we noted earlier, the United States never left). The decision to return the pound to prewar parity (a rate too high given its economic fundamentals) meant the United Kingdom economy would ‘struggle with a strong currency, high unemployment, and gold losses’ (Obstfeld & Taylor, 2017, p. 8).

While the gold-exchange standard was based on the same gold convertibility rule as the classic gold standard, there were a number of key differences. The first was under the gold-exchange standard, both gold and foreign exchange were used as reserves by countries outside of the United Kingdom and the United States. Bordo and MacDonald (2003, p. 1) note this ‘reduced the disciplinary power of gold movements since it increased the possibility of sterilisation operations’; in terms of an institution’s framework, this is problematic as it reduced enforcement of the rule around price level adjustment to correct imbalances (via the price-specie flow mechanism). The consequence was persistent external imbalances, which put pressure on the gold exchange standard.

There was a second key difference between the regimes around informal institutions. Relative to the previous period, there was a ‘growing importance of domestic factors as the final determinant of monetary policy’ (Triffin, 1946, p. 57)—a reflection of the extension of voting leading to a rise of unionism and parliamentary labour parties (Eichengreen, 2019, p. 42); this meant it ‘was uncertain how authorities would react if forced to choose between defense of the gold standard and measures to reduce unemployment’ (Eichengreen, 2019, p. 67). Obstfeld and Taylor (2004) and Eichengreen (2019) note this tension meant under the new regime the currency’s value would always be defended held less credibility. Eichengreen (2019, p. 42) notes this lack of credibility meant when ‘the system was distributed, financial capital that had once flown in stabilising directions took flight. . .’.

Bordo (2021) notes there was a convention or ‘entente’ that central bank cooperation was needed to make the gold-exchange standard regime work (the 1927 Long Island meeting to stop the outflow of gold from the Bank of England is noted favourably by Bordo, 2021 in this regard). But Bordo (2021) notes this cooperation was trying to prop up a flawed system (for reasons cited above): in one way, an informal institution was substituting for a flawed formal institution. Furthermore, the Bank of International Settlements, established in 1930, was also seen as positive for promoting central bank cooperation, in addition to facilitating reparation payments. However, as we will see later, towards the end of the gold exchange standard, various events contributed to people having concerns about the future of international monetary cooperation. Further, Bernanke and James (1991, p. 36) note any central bank cooperation did not go far enough since no central bank took ‘responsibility

for the system as a whole'; Eichengreen (1992) backs this view that the reason for the interwar monetary instability was the lack of cooperation between central banks.

The gold exchange standard ended with the Great Depression. With the United Kingdom going off gold in 1931 and the United States in 1933, as figure 4.1 shows most countries had followed by 1935.

The managed float

The move off gold resulted in the final monetary regime of the interwar era: the managed float. The benefit of not having to defend a fixed exchange rate was countries could now conduct independent monetary policy. The move off gold also resulted in a sterling block—a group of Commonwealth countries that pegged their currencies to the pound,¹⁰ and a 'little dollar block'—countries which pegged to the U.S. dollar (Eichengreen, 2019, p. 81).

The convention of managing the exchange rate, via Exchange Equalisation Accounts, was a source of tension between the United States and the United Kingdom and possibly uncertainty. Harris (2021, para. 7) notes:¹¹

[f]rom late 1933 to the spring of 1936, distrust was so pervasive that, rather than discuss their concerns, they rarely even talked. And when they did talk, the tension was palpable. In May 1936, U.S. Secretary of the Treasury Henry Morgenthau Jr. berated the British financial attaché, 'if we were at war with each other we could not be acting any differently'.

An agreement between the two nations (and with France) was reached in September 1936 to co-operate and the issue was resolved.

Finally, there was an important formal institutional change post the Depression: central banks lost their independence—a response to their perceived responsibility for the Great Depression (Schenk & Straumann, 2016, p. 331). The Federal Reserve would not regain its independence until 1951 (with the Treasury-Fed Accord) and the Bank of England until 1997.

4.2.3 Bretton Woods

The Great Depression left a number of legacies. The first was a fear of countries using tactics, such as tariffs and exchange controls, to boost domestic demand at the expense of their trading partners (Obstfeld & Taylor, 2017). This meant any new monetary system had to have sufficiently stable exchange rates to promote international trade and thus reduce the temptation of these kinds of policies. This had to be balanced against a desire for some flexibility so countries could support their own domestic objectives—a second legacy of the Depression (McKinnon, 1993). The third legacy of the Great Depression was governments were less willing to tolerate unregulated capital flows. The result was a monetary regime with fixed by adjustable exchange rates with little capital mobility: Bretton Woods.

Obstfeld and Taylor (2017, p. 10) note Bretton Woods solved the trilemma by 'eliminating capital mobility' to achieve exchange rate stability and a 'degree of autonomy of monetary policy'. The capital mobility index concurs with this assessment of capital flows (see table 4.1); the index value in 1945 and 1970 was similar to 1919—another regime synonymous with low capital mobility.

¹⁰This persisted through to 1972; see Schenk and Straumann (2016, p. 338).

¹¹<https://bankunderground.co.uk/2021/09/24/battle-of-the-exchange-funds/>; accessed 23 November 2021.

The Gold Reserve Act of 1934 set the U.S. dollar gold price at 35 dollars an oz. The remainder of the key institutions of the Bretton Woods were set out in the Articles of Agreement of the International Monetary Fund. Countries:¹²

1. were required to declare a par value at which they would convert either their currency to gold, or their currency to another country convertible to gold;
2. could change par values by less (more) than 10 per cent to correct a 'fundamental' disequilibrium with consultation with the IMF (with approval of the IMF);
3. were allowed to maintain capitals control;
4. were allowed to maintain controls on current account transactions for a limited period.

The above requirements meant the United States had two obligations: buy and sell gold in exchange for dollars at the prescribed rate (35 dollars an oz.) and create no more dollars than the stock of US gold could support; it was the responsibility of other central banks to intervene to keep the dollar value of their currencies at the required level (Yarbrough & Yarbrough, 2003, p. 605).

As an institutional set-up, Bretton Woods had a number of problems. Firstly, there was no enforcement mechanism to hold the United States to its obligations.¹³ Tooze (2018, p. 10) notes the US dollar was only tied to gold by 'convention' and when it became too difficult to live with (i.e. conflicted with domestic objectives) they abandoned it. What was needed was an enforcement mechanism, such as 'independent and conservative monetary authority or some other feature discouraging any country from pursuing expansionist monetary policies' (Giovanni, 1993, p. 23). A second problem was the phrase 'fundamental disequilibrium in the balance of payments' in the Articles of Agreement, on which an adjustment in a country's par value was contingent. This phrase was undefined (Bordo & Schwartz, 1999; Bordo, 2021); there was uncertainty around when an adjustment should and should not take place and rather than being viewed as readjustment, devaluation became seen as a sign of failure, an example of the institution itself creating uncertainty.

Overall, Bordo (2021, p.595) notes the rules (the formal institutions) were 'both analytically flawed and incomparable with the political economy environment of the time'. Further, Bordo (2021) classifies Bretton Woods as another example of a situation where central bank cooperation (an informal institution) attempted to compensate for flawed formal institutions; the gold pool—where central banks co-operated to keep the gold market price in line with the official value—is an example of one such arrangement, as were lines of credit amongst central banks (Schenk & Straumann, 2016).

Following Bordo and Schwartz (1999), for the purposes of our analysis, we split the Bretton Woods regime into two sub-regimes: the pre- and post-convertible phases. We do this because in the post-convertible regime, an informal institution—G-10 co-operation—replaced a formal institution ('capital controls') (see Bordo & Schwartz, 1999). This shift has important implications for the types of uncertainty we would expect to observe. Yarbrough and Yarbrough (2003) note the lack of capital account currency convertibility limited private capital flows, with the result maintaining current account deficits were funded either through central bank foreign exchange sales

¹²This list draws on Eichengreen (2019, p. 90-91).

¹³Bordo (1995) notes the enforcement mechanism for other countries was access to US capital and IMF resources.

or borrowing. Central bank foreign exchange sales were particularly problematic as central banks/governments needed enough reserves to defend their exchange rate. The rise in capital flows once capital account convertibility was established brought the new challenge of speculative capital flows, making maintaining fixed exchange rates more difficult.

4.2.4 Post-Bretton Woods

Just as the study of Nurkse (1944) was influential in getting the architects of the Bretton Wood regime to reject floating exchange rates, the writings of Milton Friedman (for example, Friedman, 1953) were influential in the adoption of floating exchange rates after the demise of the Bretton Woods regime. In general, in the post-Bretton Woods era, autonomous monetary policy and freedom of capital controls have been achieved at the expense of exchange rate stability. However, as the period has been far from uniform, so below we outline the key developments with respect to exchange rates, monetary policy and capital flows from an institutional point of view.

Exchange rates

In August 1971, President Nixon suspended foreign central banks from converting U.S. dollars to gold (that is, he 'closed the gold window'). The result, in the words of Humpage (2013, para. 6) was:

'[a] crisis atmosphere prevailed. Many key foreign currencies began to appreciate against the dollar, despite heavy intervention. Restraints on cross-border financial flows began to emerge. Monetary officials around the globe feared international monetary relations would collapse amid the uncertainty about exchange rates, the imminent spread of protectionism, and the looming prospects of a serious recession.'

The initial response was the so-called Smithsonian Agreement, still a set of fixed exchange rates (albeit with more permissive bands) against (a now devalued against) U.S. dollar. European currencies, including the pound, created their own arrangement within the Smithsonian's wider bands— 'the snake in the tunnel'—an agreement to keep bilateral exchange rates within a tighter band than possible under the Smithsonian Agreement.¹⁴ The snake in the tunnel collapsed owing to speculative pressures, with the United Kingdom leaving in 1972 to float. The U.S. dollar went freely floating in 1973. The general uncertainty about floating at that moment in time is well captured by this New York Times quote when the pound floated:

'it would have done neither Britain nor the world any good for the British to slide back into their characteristic postwar position, desperately trying to grow while husbanding inadequate monetary reserves. Nevertheless, a world that has grown more sophisticated about self-defeating exchange-rate rigidity remains frightened of flexibility. So the floating of the pound is regarded as a "crisis" because of the threat it poses to the two principal arrangements for pegging rates that have followed the breakdown of the Bretton Woods system, which was signaled last Aug. 15 by President Nixon's decision to cut the dollar loose from gold.'¹⁵

¹⁴This European agreement marked the end of the Sterling Area.

¹⁵<https://www.nytimes.com/1972/06/29/archives/snake-in-the-tunnel.html>

A convention of the time was intervening in the currency market. Eichengreen (2019, p. 132) notes the Canadian dollar, French and Swiss francs, lira, yen and pound were all actively managed (using monetary or fiscal policy or both); while the Federal Reserve intervened to smooth the day-to-day fluctuations in the currency (as opposed to trying to influence the trend). Bordo (2015, p. 211) sets out the rationale for the interventions, as well as assessing their success:

Although monetary authorities eventually accepted floating exchange rates, they continued to view the foreign-exchange market as inherently prone to bouts of disorder. Monetary authorities never clearly articulated the market failure underlying this alleged disorder, but they seemed to believe that information imperfections could cause exchange rates to deviate from their fundamental values, create excessive volatility, and foster destabilizing speculation. Under such conditions, they contended, foreign-exchange intervention could help direct exchange rates along a path consistent with fundamentals and could do so with lower volatility than otherwise would be the case. An official presence, particularly on the part of the United States, was necessary to maintain market order. The record of US operations between March 1973 and April 1981, however, was equivocal at best. The United States intervened almost exclusively in support of the dollar, but during nearly every operation, the dollar continued to depreciate. To be sure, US interventions at the time often sought only to smooth dollar movements, not to prevent or reverse them.

Bordo (2021) argues this coordinated exchange rate intervention did not work because most central banks did not follow the other rule required: keep inflation low. A second difficulty is knowing when it is appropriate to intervene. Yarbrough and Yarbrough (2003) show that in a managed float world, there are two rules: respond to temporary disturbances in the foreign exchange market but not to permanent ones—uncertainty, therefore, arises from determining whether a disturbance is temporary or not.

A second key period in the post-Bretton Woods era regarding exchange rates is the period 1985-1992. During this period, there were two accords: the Plaza accord, an agreement amongst the G-5 to depreciate the dollar to reduce U.S. trade imbalances (particularly against Japan), and the Louvre accord, an agreement between the G-7 (minus Italy), to halt the decline of the U.S. dollar via coordinated policy. The key obligation for the participating countries (the U.S., Germany, Japan) was to achieve 'broad target zones for the mark/dollar and yen/dollar exchange rates' (McKinnon, 1993, p.29); the conventions followed by other countries were: 'support, or not oppose, interventions by other countries'. (McKinnon, 1993, p.29).

The narrative above about exchange rate regimes is a US-centric one. More needs to be said about the European situation. Post-Bretton Woods, a system needed to be devised to avoid fluctuating intra-European exchange rates and, thus, no disruptions to the integrated trade networks within Europe (Tooze, 2018, p. 92). As noted earlier, early attempts failed. Beginning in 1979, after a brief period floating against the dollar, the members of the European Economic Community, excluding the United Kingdom (who kept floating), operated a system where exchange rates should fluctuate inside fixed margins.¹⁶ Capital controls meant that domestic policy autonomy persisted and realignment was permitted when imbalances arose. The

¹⁶Exchange rates were fixed relative to a weighted average of participating countries.

problem with the system from an institutional perspective was there was no clear mechanism to trigger countries to adjust their monetary policy to maintain their exchange rate in the band (Eichengreen, 2011, p. 81). As capital restrictions eased, it was argued closer European integration was needed to ease pressure on exchange rates (Tooze, 2018, p. 92). Thus, the idea of a common European market was re-launched and legislated for; the Delors committee, meanwhile, (re)started work on a common monetary union—this was eventually legislated for in 1992.

The pound joined the European Exchange Rate Mechanism (ERM) in 1990. In a *Times* article, Edward Heath, an ex-PM, argued the case for membership so to: ‘check the instability of exchange rates which was seriously damaging to business. . . Trade, investments, jobs are all at stake.’ He noted the exchange rate instability reflected the instability of oil prices—Britain having large deposits in the North Sea.¹⁷ the United Kingdom crashed out of the ERM in 1992, but the other European countries marched on, eventually adopting a common currency in 1999.

Since 1992, there has been a block of developed country currencies with floating exchange rates (including the United States and the United Kingdom) and a block with fixed exchange rates (the ERM and then the Euro). There have been a series of exchange rate interventions by U.S. and other countries’ monetary authorities when it was felt exchange rates were misaligned with economic fundamentals, although Schenk and Straumann (2016) note since the early 2000s, industrialised countries have withdrawn from such interventions (see figure 4.2).¹⁸ Since 1992, emerging countries, in general, have moved towards floating exchange rates, with the per cent of emerging countries floating rising from 17 per cent in 1990 to 47 per cent in 2006 (Eichengreen, 2019, table 6.1, p. 178).¹⁹

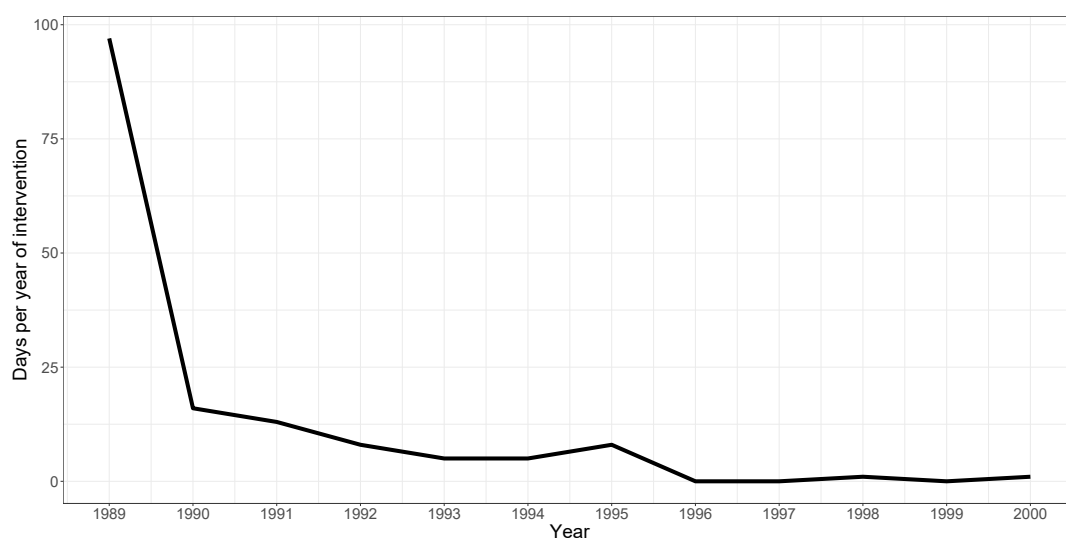


FIGURE 4.2: Days of US interventions in Foreign Exchange Markets (1989-2000)

Source: Yarbrough and Yarbrough (2003) Table 20.7, p. 615

¹⁷Haviland, J. ‘Heath call to join EMS’, *The Times*, February 8, 1985.

¹⁸<https://home.treasury.gov/policy-issues/international/exchange-stabilization-fund/exchange-stabilization-fund-history> [accessed 20 October 2021].

¹⁹In ‘other developing’ countries, soft pegs are still the preference in the majority (55 per cent in 2006) (Eichengreen, 2019, table 6.1, p. 178).

The ability to direct monetary policy towards domestic objectives

Post-Bretton Woods, both the United States and the United Kingdom have been able to conduct independent monetary policy (the exception being the United Kingdom's brief membership in the European Exchange Rate Mechanism) with the goal of achieving a stable inflation level, although the specific conduct of monetary policy has changed over time.

Goodhart (1989) divides the early part of the period into four parts. The period up until 1978, he characterises as the 'shift towards monetarism'—a period where a number of countries adopted published monetary targets, including the United States in 1975 and the United Kingdom in 1976. Goodhart (1989) notes many commentators doubted the commitment of the authorities to the targets and notes authorities were generally poor in hitting these targets. Whelan (2021, p.2) notes that central banks lacked faith in the ability of monetary policy to influence aggregate demand. Further, because inflation in the period was seen predominately as 'cost-push', the best response was through to price and wage controls (a formal institution).

Goodhart (1989) classes the next period—1979-1982—as 'the high water-mark of national monetarism'. In the words of Nicholas Kaldor, as quoted in Reichart and Slifi (2016, Footnote 11, p. 112):

The 'new' policy of the Federal Reserve, formally announced by Mr Volcker, the Chairman of the Federal Reserve Board, on 6 October 1979, was to secure a slow and steady growth of the monetary aggregates M1 and M2 by varying the reserves available to the banking system through open-market operations, irrespective of the accompanying movements in the rates of interest.

That is, the Federal Reserve moved from controlling the Federal Funds rate to controlling non-borrowed reserves. Goodhart (1989) credits the Federal Reserve actions during this period for shifting 'from the generally inflationary conditions of the 1970s to the generally deflationary conditions of the 1980s' (p. 301). The United Kingdom went down the similar route of strict monetary targeting during this period—a target rate for M3 of between seven and eleven per cent was announced in 1979 and retained in 1980 (Champroux & Sowels, 2015); the United Kingdom, however, did not control reserves, sticking with the interest rate, but added controls on government spending and deficits (the so-called Public Sector Borrowing Requirement).²⁰

The next period—1982 to 85—is termed the 'return to pragmatism' by Goodhart (1989). The effects of financial deregulation and disinflation on the velocity of money meant it became increasingly difficult for policymakers to identify an appropriate money supply growth rate (Carlson & McElravey, 1989); this meant 'the Fed moved, at broadly the same speed as in the United Kingdom, down the road of widening the range of monetary targets/indicators, and returning to a more discretionary and pragmatic mode of determining money market rates'(Goodhart, 1989, p.309).²¹

The 1990s saw the adoption of explicit, legislated, inflation targets (a formal institution) in many countries. The advent of inflation-targeting saw inflation expectations become the nominal anchor; figure 4.3 tracks the increase in the number of central banks inflation-targeting since 1989 (taken from Ilzetzki et al., 2019, table

²⁰See Champroux and Sowels (2015).

²¹The final period Goodhart (1989, p.308) discusses is from 1985 'onwards' (the paper was published in 1989), which he characterised as where there was 'increasing concern for exchange rate regimes'—we have discussed these regimes above.

A.4). In terms of United Kingdom and the United States, Ilzetzki et al. (2019, table A.4) date the United Kingdom as starting inflation targeting in 1992, but records no entry for the United States. Others have dated the United States starting explicit inflation targeting in 2012 but argue the United States has been implicitly inflation targeting since 1996, although this was not made public (see Wessel, 2018).

Another important institutional change with respect to monetary policy, that has occurred co-currently with inflation targeting, has been central bank independence. The cross-country mean of the central bank independence scores of Garriga (2016) is plotted in Figure 4.4; the score shows a marked increase since 1990.²² Amongst many things, central bank independence has limited the ability of governments to use monetary policy to achieve their electoral ambitions. Schenk and Straumann (2016) note increased central bank independence from political objectives, following the low point of the 1970s. This was accompanied by an awareness of international economic policy interdependence and increased central bank cooperation—the provision by the Federal Reserve of dollar swap lines during the Global Financial Crisis (GFC) is one example.

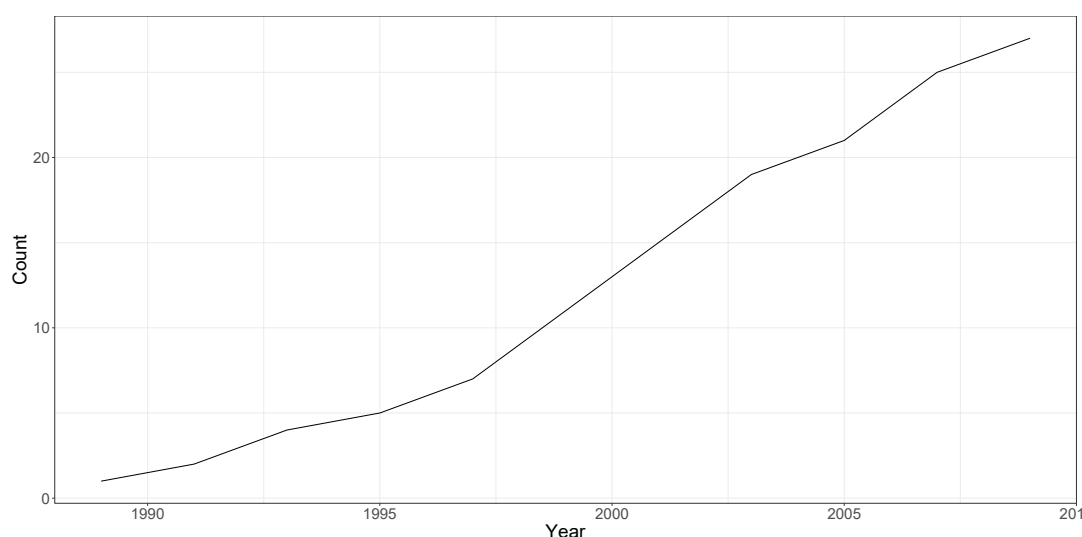


FIGURE 4.3: Countries that are inflation targeting

Source: Ilzetzki et al. (2019, table A.4)

Finally, a comment on monetary regimes in the post-GFC world. Although the nature of the monetary regime remains broadly unchanged prior to the GFC, there have been several significant changes. Firstly, in 2012, the Federal Reserve announced its first explicit inflation target. Second, there has been an increased focus on financial stability by central banks; Edwards (2021) and Vollmer (2021) document the resurgence of macroprudential policy/regulation since 2009.²³

Thinking about these recent developments from an uncertainty point of view, we begin by noting Obstfeld and Taylor (2017) identify the existence of financial trilemma. There is no way to simultaneously have: (1) national control over financial policies; (2) financial integration with the global market; (3) financial stability.²⁴

²²This is her weighted score, where the weights are applied to different categories that make up the index.

²³In contrast, Capraro et al. (2021) note that Federal Reserve monetary policy has given increasing attention to financial stability since the 1990s.

²⁴The original statement of this trilemma appears in Schoenmaker (2013).

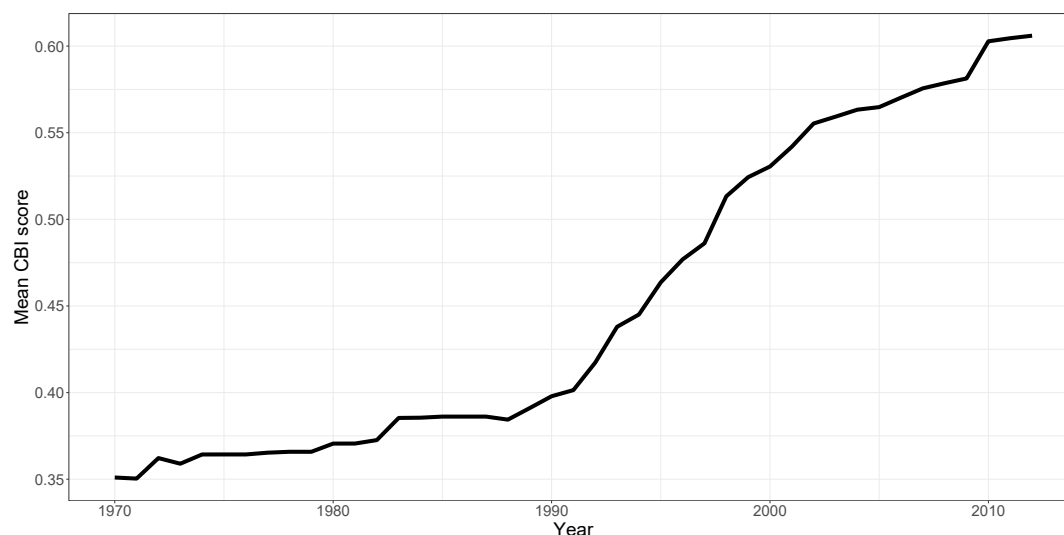


FIGURE 4.4: Average (mean) of central bank independence scores from Garriga (2016)

Note: Bounded between zero (min) and one (max)

Obstfeld and Taylor (2017, p. 18) go on further to note: ‘because of the financial trilemma, moreover, domestic monetary policy, under an open capital account and a floating exchange rate, even if more autonomous than under a pegged exchange rate, will likely face a harsher tradeoff between conventional macroeconomic goals (inflation, output) and financial stability’. In short, the GFC, by putting more focus on the central bank’s role in ensuring financial stability, has put the financial stability/inflation tradeoff in sharper relief and this maybe a source of uncertainty, particularly as the influence of macroprudential tools on the effectiveness of monetary policy is unclear (Vollmer, 2021).

Rey (2016, p. 2) notes another issue related to the financial stability/monetary policy nexus: ‘in a world of globalized finance with different types of capital flows and financial market imperfections, key countries’ monetary policies may affect other countries’ monetary conditions and financial stability in several ways.’ Thus, ‘[in] such a world, letting the exchange rate float may not be enough to insulate the domestic economy, even if it is a large country, from global factors and permit monetary policy independence’.

Another change post-GFC is, owing to the existence of a zero-lower-bound on interest rates, alternative instruments have been used to achieve inflation targets: forward guidance and quantitative easing. From an institution’s point of view, forward guidance (a new convention) is interesting as there is no enforcement mechanism holding central banks to the commitment they make (Haberis et al., 2017). Thus, there is a question of whether the certainty supposed to be achieved by forward guidance does occur, despite the absence of an enforcement mechanism.

A final change post-GFC is around the role of fiscal policy in terms of a macro-stabilisation tool. A sort of code of behaviour (an informal constraint) enforced on governments in the 1990s, reflecting the political business cycle literature, was fiscal policy should play no role in macro-stabilisation. This represented a marked change from the 1960s, where the ideas of Keynes (in particular) meant fiscal policy was seen as the primary tool of macro-stabilisation. Post-GFC, there are some who hold a ‘new view’ of fiscal policy, closer to the 1960s view that there is a role for fiscal policy

in macro-stabilisation. In particular, some contend fiscal policy is often beneficial for effective counter-cyclical policy as a complement to monetary policy (see Furman, 2016).²⁵

Capital flows

The general trend since Bretton Woods has been for increased capital mobility. The United States was early in liberalising its financial flows: for example, in 1974 it stopped capital controls on outflows. On the international stage, it also pushed for reducing capital controls; the U.S. delegation managed to insert the phrase ‘the essential purpose of the international monetary system is to provide a framework that facilitates the exchange of goods, services, and capital among countries’ into the IMF’s Articles of Agreement (Ostry et al., 2010, p. 21). On the other hand, the United Kingdom kept strict controls on capital outflows until 1979, thus lagging behind G-7 countries (Ostry et al., 2010, p. 19). More generally, as figure 4.5 shows, there was a degree of heterogeneity across countries in terms of their financial openness, although a general theme is openness significantly increased in the 1980s. This is in line with Ostry et al. (2010, figure 6), which shows the sharp drop in controls on capital inflows and outflows from the 1980s and 1990s until they are essentially non-existent in the 2000-2010 period and beyond in developed countries.

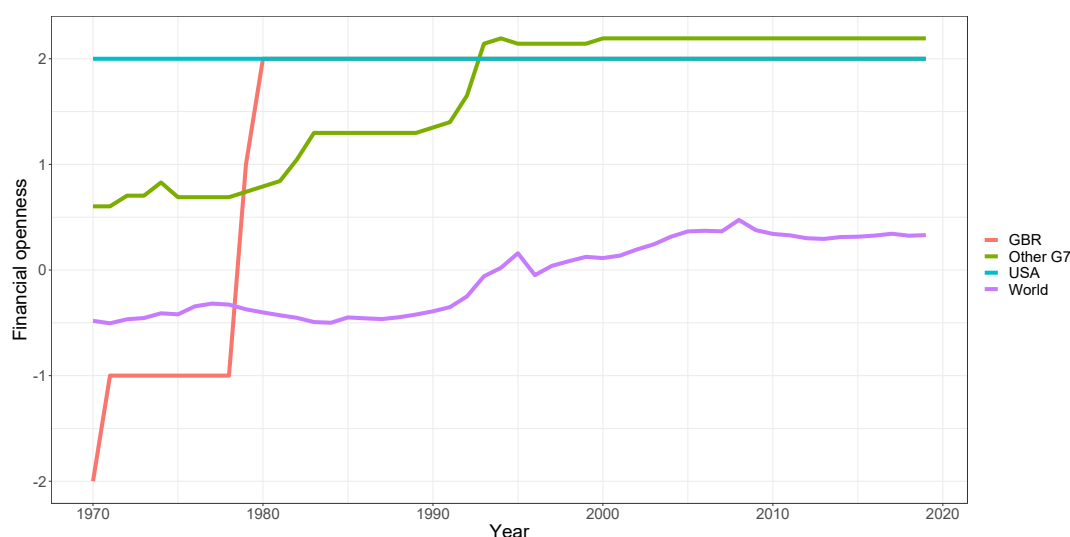


FIGURE 4.5: Chinn-Ito Financial Openness Index

Source: Chinn and Ito (2006)

Note: Over time, and across all countries, the index has a minimum value of -1.92 and a maximum of 2.32.

4.2.5 My regimes

In order to understand how uncertainty has varied across different regimes, we first need to define some regimes; these are set out in table 4.2. Up until the end of Bretton Woods we generally adopted the regimes of Bordo and Schwartz (1999); note we treat the World Wars as separate regimes as, generally, the existing monetary

²⁵<https://voxeu.org/article/new-view-fiscal-policy-and-its-application>

institutions were abandoned or put on hold during the wars. For the post-Bretton Woods era, we initially followed the classification of Goodhart (1989), then we split the post-1992 period into three parts. The period 1992-2008 is called ‘inflation targeting I’, while the period 2009 to 2014 is called ‘inflation targeting II’. We distinguish between the two periods for reasons articulated above at the end of section 4.2: that is, post-GFC, there have been changes to the institutional arrangements around explicit inflation targets in the United States, financial stability, the conduct of monetary policy and the conventions around the role of fiscal policy.

Regime	Start	End
Classical gold std	1890	1913
WW1	1914	1918
General floating (interwar)	1919	1924
Gold exchange standard	1925	1931
Managed float	1932	1938
WW2	1939	1945
BW: pre-convertible	1946	1958
BW: post-convertible	1959	1971
Transition	1972	1978
Money targeting	1979	1985
Plaza and ERM	1986	1992
Inflation targeting I	1993	2008
Inflation targeting II	2009	2014

TABLE 4.2: My regimes

4.3 Assembling our text database

4.3.1 Creating a Corpus

Our general methodology for identifying articles of interest and constructing an uncertainty index is based on that used by Baker et al. (2016) to construct a policy uncertainty index for the United States; this methodology has been adopted for a number of other countries and other specific policy uncertainty indices (for example, trade policy uncertainty, see Caldara et al., 2020; and monetary policy uncertainty, see Husted et al., 2020).²⁶

Our corpus was constructed by conducting a search on the following selection of publications:

1. *The New York Times*
2. *The LA Times*
3. *The Times*
4. *The Guardian*
5. *The Observer*
6. *The Wall Street Journal*

²⁶See <https://www.policyuncertainty.com/> for adoptions of the Baker et al. (2016) policy uncertainty index to other countries and specific policy areas.

7. *The Economist*

In order to isolate articles of interest, we sourced articles that were returned with the following search:²⁷

((‘uncertainty’ OR ‘uncertain’) AND (('monetary polic*') OR ‘gold standard’ OR ('bretton woods') OR ('monetary regime*') OR ('monetary system*') OR ('floating exchange rate*')) AND (economic OR economy))

We restricted our search to full text ‘articles’ or ‘front page’ articles. Our first year is 1890 to be inline with Bordo and Schwartz (1999) and our last year is 2014. The year 2014 is our latest year as this is the last year *the Economist* Historical Archive goes to. Table 4.3 sets out the specific databases we used for each newspaper.

Publication	Start date	End date	Database
New York Times	1890	2017	Proquest Historical Newspapers
LA times	1890	1996	Proquest Historical Newspapers
LA times	1997	2014	Proquest
Wall Street Journal	1890	2003	Proquest Historical Newspapers
Wall Street Journal	2004	2014	Proquest
Guardian/Observer	1890	2003	Proquest Historical Newspapers
Guardian/Observer	2004	2014	Proquest
The Times	1890	2014	The Times Digital Archive
The Economist	1890	2014	The Economist Historical Archive

TABLE 4.3: Publications by source

4.3.2 The data cleaning process

Our text cleaning exercise took the form of a number of steps:

1. Remove of all punctuation, digits and one-character words.
2. A spelling check of the remaining words using the ‘hunspell’ spelling package in R.²⁸
3. Remove any words spelt incorrectly.
4. Remove common terms that are not part of the article but meta or sundry information. This includes the newspaper’s title and the database it was sourced from, as well as page numbers.

The reading of text data from digitised sources, via Optimal Character Recognition, is not perfectly accurate, hence our choice to remove misspelt words. We tried correcting the misspelt words. For a misspelt word, we used the R package hunspell

²⁷There was a slight variation in the searches between publications (in terms of the specific wildcards). This is because the wildcards appeared to operate differently between databases so we adjusted them in some instances to be comparable in what they were returning across databases. For *The Economist*, we did not add ‘economy’ or ‘economic’ to our search. This is because *The Economist* is a specialist current affairs/business newspaper. On reflection, this argument could have been made with respect to *The Wall Street Journal*. However, our access to the Proquest Historical Newspaper archive had been by special, time-limited, arrangement and we were not able to go back and do this.

²⁸Ooms, J. (2017). hunspell: High-performance Stemmer, Tokenizer, and spell checker for R. R package version 2.6. <https://cran.r-project.org/package=hunspell>.

to provide a suggestion and calculated the Damerau-Levenshtein distance between the misspelt word and the suggestion.²⁹ We then experimented with accepting the suggestion under different thresholds for the Damerau-Levenshtein distance (1,2,4 were tried). Our investigations indicated that many of the suggestions were incorrect, reflecting that some words were broken into parts when machine read, making it hard for accurate suggestions to be made. We, therefore, omitted misspelt words; the cost of this approach is that potentially important information was lost.

There were instances where the same article was returned twice in the search under the same or a different title. Any duplicated articles were deleted. To do this, we searched for exact duplicates, but also articles where the text was deemed to be ‘similar’. We searched for similar documents because the reading in process can result in minor variations from the same document. The implication of this is if the same article was read twice it would not be an exact duplicate. The similarity between texts was calculated using the following formula:

$$1 - d(\text{text}_1, \text{text}_2) / \max(A, B) \quad (4.1)$$

where d is the Levenshtein distance function and A and B are the lengths of the first and second text respectively.

For each pair of texts, this returns a value between zero (lowest similarity) and one (highest similarity). When a pair of texts had a similarity of more than 0.7, one text was dropped (at random).³⁰

Table 4.4 shows our final counts of articles by publication, as well as the last year an article was found for that publication. In total, we have 10,544 articles in our final corpus.

Publication	Number of articles in the final Corpus
New York Times	2117
LA times	609
WSJ	3021
Guardian/Observer	1631
The Times	1956
The Economist	1240

TABLE 4.4: Final counts of articles from each publication

4.4 Measuring the overall level of uncertainty

Our first research question was as follows: which monetary regime had the lowest uncertainty associated with it? As we noted earlier, to answer this question, we construct an annual index using a methodology similar to Baker et al. (2016). The index is constructed in the following steps:

1. For each publication, the number of articles returned by the search outlined in section 4.3 is aggregated each year.

²⁹The Damerau-Levenshtein distance is a measure of how many character changes including transpositions are required to move from the suggested correct word to the original misspelt word.

³⁰This was implemented using R’s RecordLinkage package (Sariyar & Borg, 2010). To ease the computational burden, we only tested for the similarity of articles downloaded within ten articles of each other. Based on our manual audit, this was deemed sufficient to catch duplicates.

2. As the number of articles on the economy (and the number of articles in general) are increasing each year, these counts are deflated by a count of the total number of economics-related articles published in the publication each year. This creates the newspaper-specific index.³¹
3. This newspaper-specific index is normalised by its standard deviation.
4. To mitigate against idiosyncratic publication views, we create three aggregate indices from our newspaper-specific indices: the UK-based index ('UK' for short, consisting of the *Times*, *The Guardian* and *The Observer*), the US-based index ('US' for short, consisting of the *LA Times* and *The New York Times*) and the Financial Press ('FP' for short, consisting of *The Economist* and the *Financial Times*). To create each aggregate index, we take the mean of the two relevant newspaper-specific indices.
5. Finally, each aggregate index is re-scaled to have a mean of 100.³²

Figure 4.6 plots the three aggregate indices on an annual basis; figure 4.7 set out the average (mean) for the same indices for each of the regimes.

³¹In order to get the annual counts of economics-related articles, we repeat our search of the publications but only search for the terms: economic OR economy. In line with our earlier argument that *The Economist* is a specialist current affairs/business newspaper, we count all articles.

³²The Financial Press ('FP') index is only constructed from 1920 as one of the contributing newspapers, *The Wall Street Journal*, only has sufficient numbers (more than 1000 per year) of total articles from then.

The classical gold standard

In the early part of our sample (1890 to 1905), uncertainty is relatively high, particularly in the USA-based newspapers. This is consistent with numerous events occurring around the time. Eichengreen (2011, p. 19) notes although the United States was effectively on the gold standard, its ‘commitment was uncertain’. In particular, there was a populist movement which supported a return to silver as legal tender as a way to increase the money supply and offset the deflation the economy was experiencing; their view was countered by those who worried about the inflationary consequences. The debate reached its zenith at the 1896 Democratic convention when William Jennings Bryan, in search of a (successful) nomination to contest the presidency, gave his support to the return of silver in his famous ‘Cross of Gold’ speech; Figure 4.6 shows a large spike at this point. A second large spike in uncertainty in US-based newspapers occurs in 1900. In this year, Bryan (again unsuccessfully) campaigned on the return to silver as legal tender. Further, the Gold Standard Act was passed, establishing, in law, ‘no provision for silver purchases or coinage in 1904 (Eichengreen, 2019, p. 19).³³ There is another spike in the U.S. index in 1904, another election year.

The U.S. economy also experienced a crisis in 1893; a year when the US uncertainty index spikes. Hoffmann (1956) notes the United States experienced large gold outflows from 1892–94, which many contemporary observers attributed to the aforementioned conflict over silver (Hoffmann, 1956, p.157). DeLong et al. (1999, p. 266) back this explanation ‘the 1893 crisis appears to have resulted from fears in Britain that populist political pressures would force America off the gold’. Although Hoffmann (1956, p.157) questions this explanation, noting the decline in foreign investment probably reflected the depression in Europe, he does note ‘to the extent that decision makers thought that this [silver conflict] explanation was valid and acted accordingly, these circumstances helped shape economic condition (p. 156)’. Similarly, to the extent that the public and newspaper journalists thought this explanation was valid, it would have impacted the uncertainty they felt and wrote about. This quote from a W. G. Thomes, a managing director of a large New York retail business, in an 1893 *New York Times* article captures that sentiment:³⁴

“I am decidedly in favor of the immediate repeal of certain sections of the Sherman Silver Bill. There is no doubt the uncertainty which exists regarding the money standard is the basis of much of this anxiety and uneasy feeling... To compel the Government to exchange good money for unmarketable silver is absurd on the face of it. The people who study the monetary system of the country... are doing like some foreign countries and banks — getting hold of the gold and keeping it

This outflow of gold led to low gold reserves at the Treasury, placing doubt whether convertibility obligations could be met.

The U.K. index spikes in 1891 and 1892, the time of the Baring Crisis. The Baring Crisis was initiated by a Latin American sovereign debt crisis. When the Argentinean government could not service the debt it owed the London-based Barings finance house, the finance house faced bankruptcy. Barings notified the Bank of England of its troubles in November 1890. Schenk and Straumann (2016, p. 330) note the Baring Crisis threatened to push the United Kingdom off the gold standard and

³³Eichengreen (2019, p. 18) notes the gold standard was still qualified to that point by statutes requiring the Treasury to buy silver.

³⁴‘Merchants are not uneasy’, *New York Times*, June 26, 1893.

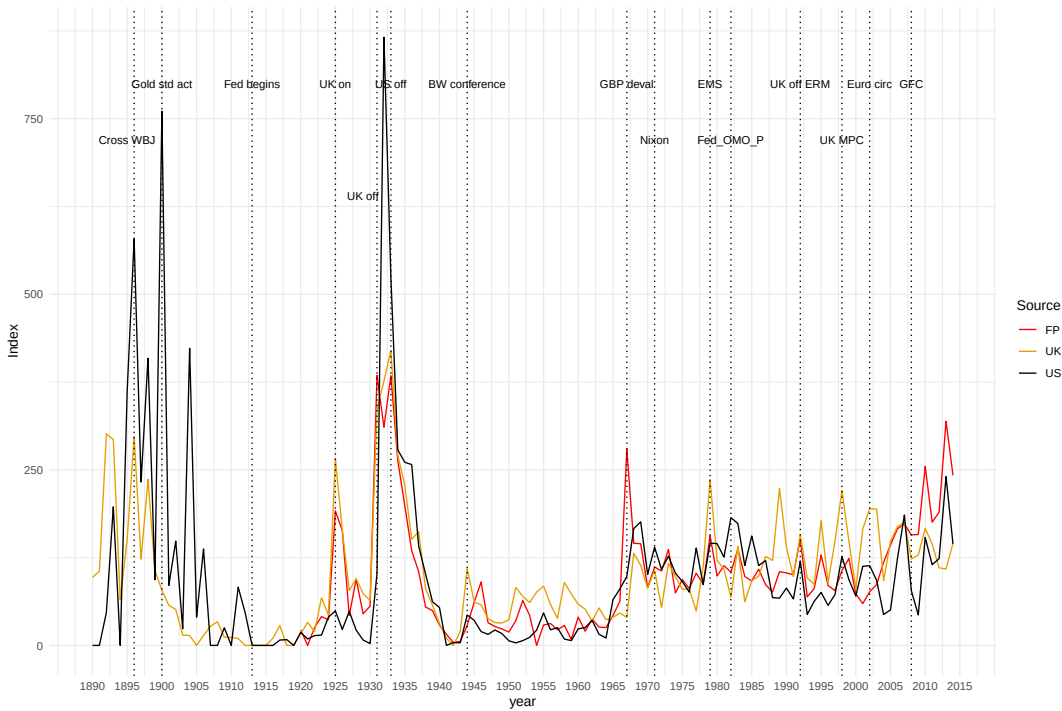


FIGURE 4.6: Monetary regime uncertainty index - annual basis

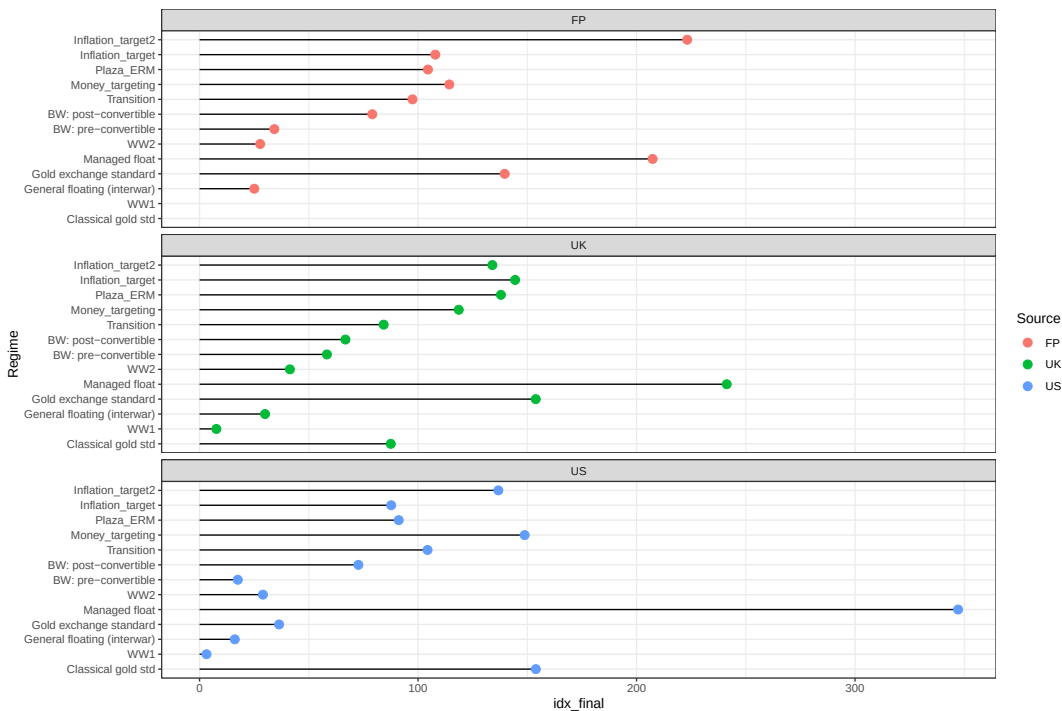


FIGURE 4.7: Monetary regime uncertainty index - regime mean

required the Bank of England to rescue Barings using gold loans from the central banks of Russia and France.

Between 1904 and 1913, there is a noticeable lack of spikes in the uncertainty indices. In particular, the panic of 1907 is a significant event in economic history, yet it does not register on any of our indices. DeLong et al. (1999, p. 267), citing a 1910 report written for Congress, attributes the panic to ‘financial stringency in Britain and the extreme vulnerability generated by America’s inelastic currency and four previous years of rapid macroeconomic expansion’. Prima facie a lack of uncertainty recorded for our U.S. index is hard to understand. It may be that the panic did not generate uncertainty about the monetary regime but rather the banking system itself. To illustrate this point, a search of *The Economist* for ‘uncert*+banking’ returned 32 articles for 1907, whereas our search (as described in section 4.3) only returned 2 articles.

We see a small spike in the US-based index in 1911 (37 per cent higher than the index’s mean). The year 1911 saw the announcement of the Aldrich plan—an initial plan for a U.S. central banking system — which took nearly two years to work through Congress. The plan created uncertainty. In the words of Teddy Roosevelt (as quoted in Johnston, 1984, p. 1) the plan “placed the currency and credit system of the United States in private hands not subject to effective public control”. Further, the Aldrich plan left many concerned that bankers would control access to credit and favour corporate borrowers. The plan was eventually rejected for a publicly-owned, decentralised proposal (which was more favourable to non-corporate borrowers) and this formed the basis for the 1913 Federal Reserve Act.

The Interwar period

The period from 1919 to 1925 —the period Bordo (1993) calls the ‘general floating period’—registers little uncertainty in either the indices based on U.S. and U.K. newspapers. This is inconsistent with the criticisms of floating exchange rates during the period by Nurkse (1944). He argued speculation led to instability in exchange rates—in particular, the Franc (Eichengreen, 2019). It may be that because we are focused on the newspapers of the United States and the United Kingdom, and not France, we see less reporting of uncertainty during the period. This is consistent with Milton Friedman’s criticism of the study by Nurkse (1944) (as reported in Eichengreen, 1992), wherein Friedman noted Nurske’s critique of floating exchange rested solely on the behaviour of the Franc. Table 4.5 shows that the Franc/USD cross rate was more volatile than the GBP/USD cross rate during the period.³⁵

TABLE 4.5: Annual percentage change in selected cross rates—1920 to ‘24

Year	USD/FRANC	USD/GBP
1920	94	21
1921	-6	-5
1922	-9	-13
1923	35	-3
1924	16	4

³⁵Calculated using exchange rates from Jordà et al. (2017).

Our finding that the United Kingdom newspapers recorded little uncertainty over the 1919-25 period is partially consistent with Lopez and Mitchener (2021). These authors use the realised volatility in daily exchange rates as their uncertainty proxy—they generally find little uncertainty for the United Kingdom over the period 1919 to 1925. Where we differ is they record two large spikes in the 1919/20 period. The lack of a spike in our index in 1919 is surprising given the sterling was unpegged from the dollar in 1919 and fell markedly (Eichengreen, 1992, p. 100).

Both the United Kingdom and the Financial Press ('FP') indices spike in 1925 as the United Kingdom went back on the gold standard (at an overvalued rate to restore pre-war parity) with the assistance of the New York Federal Reserve. As we stated in section 4.2, and as Eichengreen (2019, p. 54-55) argues, this made things very difficult for the United Kingdom as international and domestic objectives came into conflict—international objectives prevailed, resulting in high unemployment. There is another smaller spike in all three indices in 1928. To us, this, perhaps, reflects two events: the death of Benjamin Strong and the tightening of US monetary policy in 1928 as the Federal Reserve sought to undo its interest rate cut in 1927.

The death of Benjamin Strong in October 1928 would have been a source of uncertainty for two reasons. The first was whether his expertise could be replaced by George Harrison. Secondly, from a United Kingdom point of view, his friendship with Montagu Norman saw cooperation between the two central banks, particularly as Europe dealt with its low gold reserves. How the new governor would conduct himself in international affairs was unknown. On the tightening of US monetary policy in 1928, some historians argue the 1927 interest rate cut fuelled the stock bubble that led to the crash in 1929; this view was shared by President Hoover and Adolph Miller (a governor of the Federal Reserve System at the time); see Ahamed (2009, p. 300). A reversal of the cut would have therefore led to concern about the sustainability of the market rally.

The stock market crash itself in 1929, and the stock market's subsequent ongoing ups and downs, do not register on our index, whereas Romer (1990) and Greasley et al. (2001) note the stock market crash generated great uncertainty about future income. These papers proxy uncertainty with the variability of stock market returns—that is, a measure of financial uncertainty. As to why it does not register on our index, perhaps the crash did not generate immediate uncertainty about the monetary regime.

The finding that US-based newspapers record little uncertainty from 1915 to 1930 is partially consistent with Meltzer (1986) who finds, for the United States, real and nominal GDP uncertainty (both in the level and growth rate) fell during the period, before rising again after 1931. In contrast, Meltzer (1986) finds price uncertainty for both the level and growth rate rose during the period. He uses a Kalman filter to identify permanent and transitory changes to variable levels and rates of change. He then equates uncertainty with the variance of permanent changes and risk with transitory changes.

The exit from the gold standard in 1931 by the United Kingdom and, in particular, the United States in 1933 correspond to significant peaks in all indices. In the lead up to the United Kingdom's exit, and with the sterling under attack, the United Kingdom took a number of steps to defend its position: raising the discount rate (albeit modestly), obtaining foreign credit (Crabbe, 1989) and passing one of the most austere budgets in history (Morrison, 2016). The text from a *Times* article two days after the United Kingdom's exit is illustrative of the uncertainty that followed:³⁶

³⁶'The British Decision', *The Times*, September 21, 1931.

the Bank of England's decision has come as a bolt from the blue. . . all responsible European politicians in Geneva have cancelled their engagements and are undertaking arrangements to return home to deal with what is considered to be a crisis the most serious which the world has faced since August, 1914.

Indeed Morrison (2016, p. 1) calls the United Kingdom's "departure from the gold standard system remains one of the most shocking policy shifts in the history of the global economy". The United Kingdom's departure also caused speculation that the United States would leave the gold standard and a run on the dollar (Romer, 1993; Ahamed, 2009). This event, coupled with the Federal Reserve being forced to increase its interest rate in October 1931 to ensure its gold reserves were sufficient to meet its legal requirements to back its currency, will have led to an increase in the U.S. index in 1931.

U.S. uncertainty increased through 1932 as the Federal Reserve conducted open market operations to increase output and the price level. In 1933, in addition to the US leaving the gold standard, Roosevelt 'dashed European hopes of restabilizing exchange rates on agreed ground' with a 'harshly worded attack on the utility of currency coordination' (Steil, 2013, p. 26) during the London conference.

Uncertainty remains high right through the managed float period of 1931 to 1939. This could reflect, one, or a number, of things. Firstly, intense political battles were playing out, particularly in the United States. Here, one group, that included bankers, wanted a return to the gold standard out of fear of inflation (which would have eroded the real value of their assets: outstanding loans); another group, that included farmers, wanted to stay off gold in the hopes that inflation would be generated to erode the real value of their debts (Rauchway, 2015). Secondly, as discussed in section 4.2, during this period, there was tension between the United States and the United Kingdom over Exchange Equalisation Accounts to manage their exchange rates. Thirdly, the president's policy of setting the gold price on a whim (if it was known), and the press reports that the associated gold buying program was unconstitutional, may have contributed to uncertainty in the United States (Steil, 2013, p. 26). Finally, in 1936-37, the Federal Reserve doubled the reserve requirements for member banks. While there is debate if the reserve requirement change did contribute to tighter monetary policy (see Friedman & Schwartz, 1971 and Calomiris et al., 2011 for contrasting views), it will have generated uncertainty at the time in terms of the availability of bank lending. The finding that uncertainty is high during the period is consistent with Meltzer (1986) who finds real and nominal GDP uncertainty are high (but not price/inflation uncertainty) in the United States over the period 1931Q4 to 1941Q4.

The Bretton Woods regime

Before discussing uncertainty in the Bretton Woods regime, it is worth discussing the lead up period. The UK-based index, and to a lesser extent, the US-based index shows a spike in 1944—the year of the final negotiations around the Bretton Woods regime (which included the conference of the same name). The war finance, and the negotiations around Bretton Woods, were a source of great uncertainty for the United Kingdom around this time. Steil (2013) discusses the strategy of the U.S. Treasury running down U.K. reserves during the war before offering assistance to ensure in the post-war world, the U.S. dollar would be the dominant currency. Further, the United States used their superior bargaining position to fashion a new monetary

regime that suited creditors such as themselves. The United States also took advantage of the United Kingdom's weakened financial state to offer them a loan but on the condition they accepted the Bretton Woods arrangements (Steil, 2013, p. 153).

Figures 4.6 and 4.7 show once the Bretton Woods regime started, uncertainty was relatively low up until 1964. Comparing the indices over the period, what stands out is the uncertainty index constructed from UK-based newspapers is higher than the uncertainty index constructed from US-based newspapers. This is consistent with the troubles the United Kingdom had post war. We will discuss this in more detail in section 4.6, but the key points for us now are these. During the war, sterling area countries had accumulated sterling balances in exchange for supplying goods to the war effort. Eichengreen (2011, p.40) reports Britain's sterling liabilities were six times its gold and foreign exchange holdings. Initially, this situation was manageable as the United Kingdom had placed controls on the sterling area countries using these balances. A U.S. requirement, however, of currency convertibility in exchange for a war loan (announced in 1946, implemented in 1947) meant, in 1947 there was a six-week period of convertibility and huge United Kingdom reserve losses. The unsustainable nature of the situation meant convertibility controls were reinstated in 1959 (Eichengreen, 2011). Even with restrictions on convertibility, the sterling's problems were not over. The sterling was devalued in 1949—Eichengreen (2019, p. 98) describes the cause as large current account deficits (in response to a U.S.-led recession) in the sterling area (rather than the United Kingdom itself), leading to a fall in the United Kingdom's reserves as sterling area countries converted their sterling balances to dollars to buy imports. This could happen because, although convertibility was restricted, it had not been eliminated (Eichengreen, 2019, p. 98).

From 1964 onwards, we see uncertainty from the US-based newspapers steadily increase, peaking in 1969, with a further mini spike in 1971 when Nixon closed the gold window; the other indices broadly follow this pattern. It is interesting to focus on the period around the 1967 devaluation of the pound. The Financial Press indicator has a more pronounced spike in 1967 when the pound was devalued; the uncertainty indices constructed from UK-based and US-based newspapers spike in 1968 rather than 1967. This may reflect the fact the devaluation happened later in the year (18 November) or that the suspension of the gold pool—a consequence of increased gold sales post the pound devaluation—marked an even more catastrophic event for the future of the Bretton Woods regime.³⁷ Schenk and Straumann (2016) back this view, noting that once the gold pool was suspended, the market price of gold diverged from the \$35/oz fixed price and "the underpinnings of the Bretton Woods system was fatally weakened (p. 341)."

The gradual run up in uncertainty in US-domiciled newspapers from the mid-1960s is consistent with foreign government claims on the United States rising relative to the U.S. gold holdings. Claims exceeded reserves by 1963 (Eichengreen, 2011, p. 50) reducing Bretton Woods to 'a convenient fiction' (Applebaum, 2019, p. 220). Applebaum (2019, p. 220) also notes the debate about moving to floating exchange rates intensified in the period during and after the 1968 election campaign—in part, owing to the devaluation of the pound (1967) and the French franc (1969)—no doubt increasing uncertainty about the monetary regime. Indicative of this debate, Applebaum cites Milton Friedman's pleas for a floating exchange rate (a view that had the support of an estimated 90 per cent of economists, p. 223) and the description of

³⁷The gold pool was an informal institution where the central banks of members agreed to buy and sell gold to keep it at a fixed price: \$35 an oz; that price being the price U.S. dollars were convertible into gold under the Bretton Woods regime.

Arthur Burns, then Nixon's top economic advisor, of the future of Bretton Woods as 'very precarious' (although, he was still supportive of fixed exchange rates).³⁸

Despite the movements noted above, overall, the Bretton Woods' regimes were associated with relatively low uncertainty. Across all three indices, figure 4.7 suggests uncertainty was lowest on average in the Bretton Woods regimes (excepting the World Wars and the general floating regime). This finding is broadly consistent with Bordo and Schwartz (1999, table 4.1) who find GDP and inflation variability (as measured by the standard deviation, so not uncertainty *per se*) is lowest in the Bretton Woods period. Where we differ, however, is that their measures of variability are higher in the pre-convertible regime than in the post-convertible regime (see figure 4.8).³⁹ The measure of uncertainty used by Meltzer (1986), forecast errors, is closer to an accepted notion of uncertainty than the unconditional standard deviation of Bordo and Schwartz (1999). Although Meltzer (1986) uses slightly different periods, our two papers are consistent in the general finding that uncertainty in the Bretton Woods period was lower than in the periods preceding it (see figure 4.9). Where our papers differ is Meltzer (1986) finds the period after the Bretton Woods regime, which corresponds to our 'transition' regime, is broadly consistent with the Bretton Woods regime in terms of the average level of uncertainty, whereas we find uncertainty in this regime to be much higher. In terms of our finding that during the 'transition' regime, uncertainty rose, the chopping and changing of exchange rate regimes, as well as the 'fear of floating', probably contributed to this increased uncertainty.

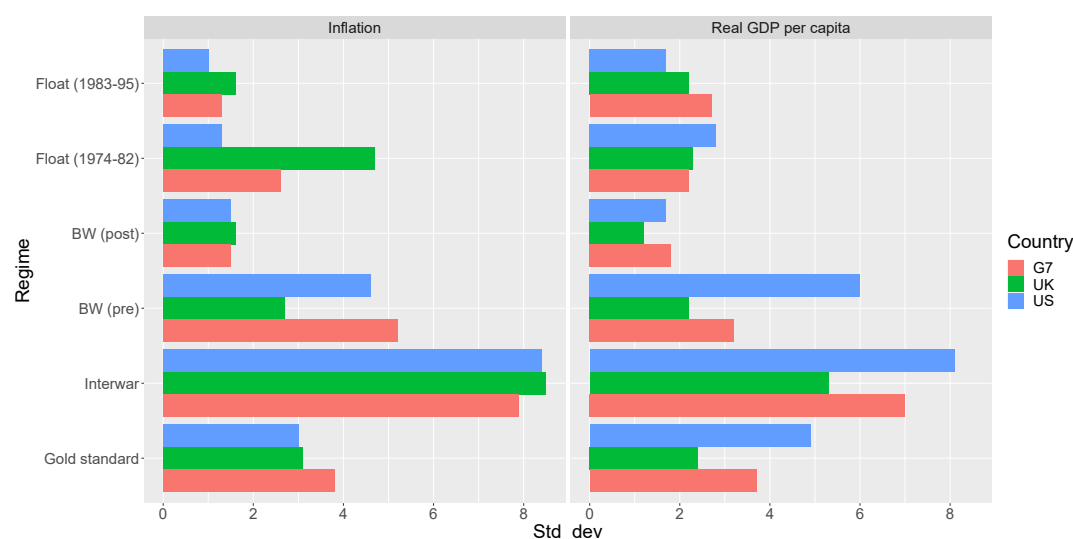


FIGURE 4.8: Uncertainty by period from Bordo and Schwartz (1999)

Money targeting and beyond

On all three indices, average (mean) uncertainty jumps again from the 'transition' regime to the 'money targeting' regime. Figure 4.6 indicates that the increase in

³⁸Interestingly, Paul Volcker was opposed to floating rates: [the idea of floating exchange rates] had had a lot of discussion in academic circles and that's where it should stay' Applebaum (2019, p. 225).

³⁹Bayoumi and Eichengreen (1994) do a similar analysis at a group level, but their sample expands from the so-called 'big 5' to the G7 post war; their results are reported in the appendix. They get similar results to Bordo and Schwartz (1999) but are more in line with us in that they find volatility/uncertainty steps up further post Bretton Woods.

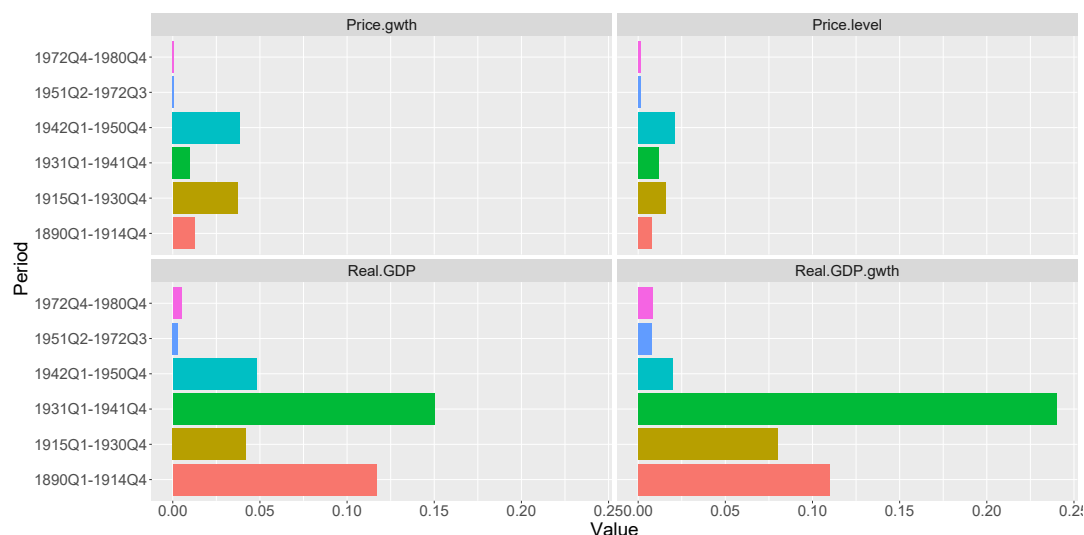


FIGURE 4.9: Uncertainty by period from Meltzer (1986)

uncertainty in the ‘money targeting’ regime reflects different dynamics in the three indices. Relative to the other two indices, the United States sees more of a level shift in uncertainty in the period 1979 to 1984. Perhaps this reflects the change to an unfamiliar instrument—reserves—as well as the lengths (in terms of unemployment) Volcker was willing to go to bring inflation down.

In contrast, uncertainty on the UK-based and financial press indices spikes in 1979 but then decreases. There were three notable events relating to the United Kingdom in 1979. The first was many of the United Kingdom’s European neighbours, and fellow members of the European Economic Community (EEC), joined the European Monetary System (EMS)—a system of stable but adjustable exchange rates—between member states of the European Economic Community (EEC). The United Kingdom was a member of the EEC but did not join the European Monetary System until 1990. Contemporary press indicates there was uncertainty if it would join even after the regime had started:⁴⁰

Lord Carrington made a speech by way of setting the general pro-European context in which the Prime Minister’s distinctly anti-European tactics for the then coming Dublin summit should be put. In the course of it he made some strikingly positive noises about British participation in the European Monetary System, which in January will celebrate its first birthday in its present incarnation. "We intend to join the EMS as soon as conditions permit and as soon as the implications for sterling of being a petro-currency are clear", he said.

The second salient event in 1979 was the Bank of England removing exchange controls; this made the problem of controlling monetary targets (which was the Bank of England’s objective) more problematic as it decreased the effectiveness of one instrument the Bank of England had been using to control money growth: the supplementary special deposits scheme (‘the corset’) (Goodhart, 1989, p. 301; Ball & Tchaidze, 1982).

The period from the mid-1980s to 2005 (figure 4.6) sees a general decline in uncertainty in the U.S. index (and the financial press index) but not in the U.K. index. The

⁴⁰Stephenson, H., ‘Siren song that should be ignored’, *The Times*, December 4, 1979

decline in the U.S. index is consistent with the so-called great moderation, a period of declining business cycle volatility, that took place during the period. The U.K. index, on the other hand, does not show evidence of a great moderation, at least with respect to monetary regime uncertainty—a number of events (potentially) explain why. Figure 4.6 indicates much of the uncertainty in the U.K. index in the period is centred around the period just prior to the pound joining the European Exchange Rate Mechanism (see the spike in 1989) and the subsequent exit of the pound from the Mechanism in 1992. As we shall explain in more detail in section 4.6, the period prior to the United Kingdom joining the European Exchange Rate Mechanism was particularly problematic from a monetary policy point of view: the goal of achieving particular monetary aggregate growth targets came into direct conflict with the target Pound/Deutsche Mark exchange rate.

Spikes in the U.K. index also occurred in 1997 and 1998. These spikes correspond to the granting of operational independence to the Bank of England in 1997 and the passing of the Bank of England 1998 Act. The Act, among other things, established a monetary policy committee and required the governor to write to parliament if the inflation target was not met.

Inflation targeting

Comparing mean uncertainty between the inflation targeting regimes pre- and post-GFC in figure 4.7 (that is, comparing ‘inflation target’ vs ‘inflation target2’ regimes), we see an uptick in uncertainty in the financial press and in US-based newspaper uncertainty indices, whereas the UK-based newspaper index is fairly stable. In terms of the divergence in the *growth in uncertainty* between the U.S. and U.K. papers, perhaps it reflects that politics is more partisan in the US than in the United Kingdom, meaning there were many commentators willing to talk up the inflationary consequences of the Federal Reserve’s quantitative easing (QE) policies. Secondly, the US was extremely exposed to the European debt crisis (Irwin, 2013; Tooze, 2018). Specifically, European banks had large dollar funding needs, which could have led to them selling their dollar portfolios in a ‘firesale’ if the Federal Reserve had not acted and provided dollar liquidity through swap lines via European central banks (Tooze, 2018, p. 206).

The financial press index registers the *highest level* of uncertainty in the ‘inflation target2’ regime. The high level of uncertainty recorded by the financial press index, perhaps, reflects one of the newspapers—*The Wall Street Journal*—is editorially conservative⁴¹ and was critical of the QE programmes in terms of its potential for inflation and interfering with private markets. This quote from *The Wall Street Journal* is indicative of the first criticism:

BOE officials have a problem: If they take further action by pumping freshly created cash into the economy – a policy tool called "quantitative easing" – they could rattle investors’ confidence in the recovery, or worse, stoke fears of inflation.⁴²

In terms of years with significant uncertainty post-GFC, figure 4.6 shows all indices have spikes in 2010 and 2013. The year 2010 was the announcement of the

⁴¹‘Unpacking WSJ’s ‘watershed’ Trump editorial’, *Columbia Journalism Review*, March 22, 2017, available at: https://www.cjr.org/business_of_news/wsj_trump_editorial_opinion.php [accessed 5/11/21].

⁴²Shah, N., ‘Europe News: For U.K., an economic balancing act’. *The Wall Street Journal*, 11 August 2010.

second round of QE by the Federal Reserve. Irwin (2013) notes this had a number of effects. Firstly, commentators raised inflation concerns. Secondly concerns were expressed (from the German finance minister amongst others) about the resulting lower dollar helping boost U.S. exports at the expense of other countries. Thirdly, there was disagreement within the Federal Reserve committee about the desirability of the QE programme (Irwin, 2013, p. 258). Finally, as we will discuss later, in 2010 the Governor of the People's Bank of China pledged to allow the Renminbi to trade more freely against the U.S. dollar (although still in a band) having prompted the creation of an international reserve currency a year earlier in a bid to diminish the status of the U.S. dollar as the world's reserve currency. Regarding the 2013 spike, it is probable this reflects the so-called 'taper tantrum', a rocky market reaction to Federal Reserve Chair Bernanke alluding to reducing bond purchases in a Congressional testimony on May 22.

In terms of the whole post-Bretton Woods period, our finding of a general decline in uncertainty in the United States is consistent with Benati and Goodhart (2010, figure 12). They find for the United States "macroeconomic uncertainty exhibits a clear peak, at all horizons, around the time of the Great Inflation, and a significant decrease thereafter" (p. 1191). Benati and Goodhart (2010) also find that uncertainty increases again following the Global Financial Crisis. They find similar results for the United Kingdom as they do for the United States, whereas our United Kingdom results are different—we find uncertainty is stable through the period. This, perhaps, reflects our specific focus on monetary issues (whereas their index captures general macroeconomic uncertainty).

4.4.1 Bretton Wood's superior performance - a case of good luck? or superiority?

Our key finding is that the Bretton Woods regime exhibited the lowest level of uncertainty (outside the World Wars and the short-lived interwar general floating regime). We also found that two of the three interwar regimes (the gold exchange standard and the managed float regime) were generally associated with high levels of uncertainty. In trying to explain similar findings, Bordo (1995) asks to what extent the reported performance of the monetary regime reflects the regime constraining actions, as opposed to the absence of exogenous shocks the regime had to deal with. Following Bayoumi and Eichengreen (1994), and other papers by these authors, he estimates a two variable vector autoregression with the rate of growth of real output and the price level (the consumer price index). He identifies the model with long-run restrictions (in the style of Blanchard & Quah, 1989): specifically aggregate demand shocks only have a temporary impact on output but a permanent effect on prices, and supply shocks have permanent impacts on output and prices. We re-estimate his model separately for both countries, using two lags as he does, using the data from Jordà et al. (2017). In line with Bayoumi and Eichengreen (1994), we use the GDP deflator as our price variable. Following Bordo (1995), figure 4.10 reports the standard deviations of supply and demand shocks by the regime; we have aggregated our regimes somewhat to avoid calculating standard deviations on too small a sample.⁴³

⁴³We also omit the post-war period, 1945-50, from the Bretton Woods regime, as, clearly this was a period of huge shocks that skew the standard deviation calculation. The actual shocks are plotted in the appendix.

Bordo (1995) argues supply shocks can be thought of as exogenous shocks the regime had to deal with. Figure 4.10 suggests that our general finding that the Bretton Woods regime exhibited the lowest level of uncertainty may reflect a favourable environment as the standard deviation of supply shocks is relatively low over the period compared to the years prior (this is consistent with the conclusion of Bordo, 1995 and Bayoumi & Eichengreen, 1994). It must be said, however, that the Bretton Woods environment was less favourable in the United States (in terms of supply shocks) than during the inflation targeting era, and our uncertainty index was higher during the inflation targeting era. As such, there may be an element of superior performance in the Bretton Woods regime as well.

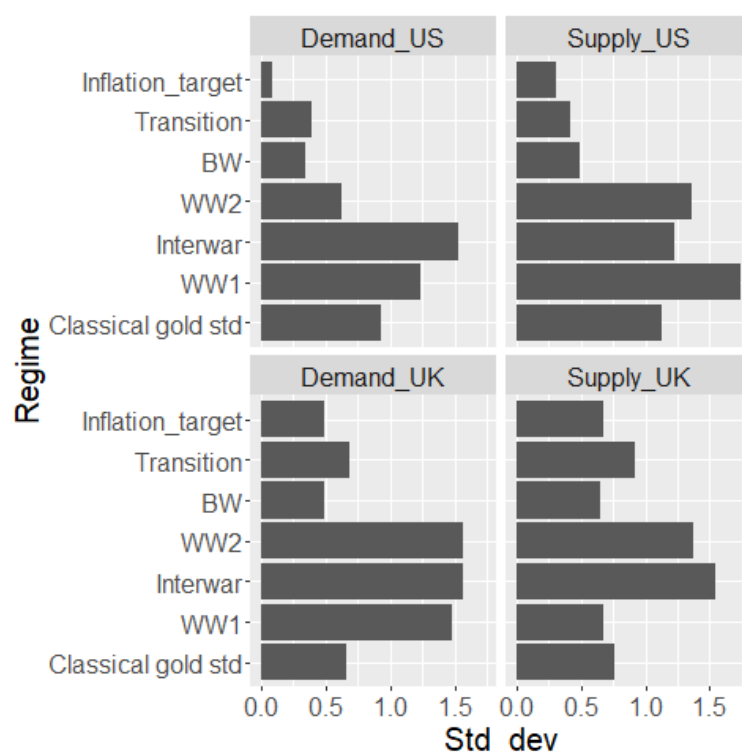


FIGURE 4.10: The standard deviation of supply and demand shocks by regime

'Interwar' is the years 1919 to 1939; 'Postwar' is the years 1946-50; 'BW' is the years 1951-71; 'Transition' is the years 1972-92; 'Inflation target' is 1993-2014.

The Bordo (1995)/Bayoumi and Eichengreen (1994) method to identify supply and demand shocks is dated and further work could be done with newer identification strategies to check the robustness of the identified supply and demand shocks. Further, Bordo (1995) notes the demand shocks are likely to reflect policy actions implying demand shocks stem from the performance of the regime itself. However, there are other sources of demand shocks than monetary sources, so further decomposing of demand shocks into monetary-related and non-monetary-related demand shocks will help, as non-monetary-related demand shocks are shocks, like supply shocks, exogenous to the regime.

4.5 A preliminary look at the different types of uncertainty

Before we undertake more sophisticated methods for identifying the topics of uncertainty, we begin with a simple method. We search for certain key terms related to certain economic concepts. In terms of the words we search for, we start with either one or two base terms that best describe the economic concept we are interested in (e.g. ‘money growth’). We then put this term into a word-embedding algorithm to search for phrases/words used in a similar way in the articles in our corpus. By similar, we mean one word/phrase could replace the other in the same context.⁴⁴

With word embedding, a word/phrase is modelled as a vector: a point in high-dimensional space (Jurafsky & Martin, 2021, p. 28). A word/phrase is deemed to have a similar meaning or context if it has a similar vector representation. The words ‘jobless’ and ‘unemployment’, for example, would have the same vector representation in the phrases ‘the jobless rate fell’ and ‘the unemployment rate fell’, as the words surrounding the terms are the same.

Various algorithms exist for calculating these representations (see Jurafsky & Martin, 2021); we use the widely used Glove algorithm (Pennington et al., 2014) as implemented in the R package `text2vec`.⁴⁵ We ran the Glove algorithm on our corpus tokenised into one word and two consecutive words (a bi-gram). In the resulting vector representation, we then searched separately for the economic concepts we are interested in (set out below in the top row of table 4.6) and found the top 20 words/phrases most similar. We then undertake a human audit of the suggested similar words/phrases and remove suggestions that are potentially ambiguous (that is, they could conceivably refer to another economic concept). The reason there is this ambiguity is best explained by an example. In commenting on monetary policy, a writer might say: ‘the inflation data warrants an increase in interest rates’; alternatively, a writer might say ‘the unemployment data warrants an increase in interest rates’. These two phrases would have the same vector representation. Hence we use word embedding as a first pass to identify possible analogies, and then we use our own judgement. Table 4.6 sets out the similar words we use to study uncertainty about output, interest rates, exchange rates and money growth. The original search terms are asterisked, and the column below the original search term reports the associated analogies. It should be noted the ‘fed. rate’ and ‘bank rate’ search were then combined into one index (interest rate uncertainty)

To understand how uncertainty has changed for the economic concepts we set out in table 4.6, we create an index in the following way:

1. For each year and each publication, we tally up the counts returned for the relevant search terms (the base word/phrase and the analogies) and normalise these counts by the number of articles in that publication for the particular year.
2. We then standardise each publication-specific index (from step 1) by its sample standard deviation.
3. We then take the mean for each publication source (e.g. UK-based newspapers, US-based newspapers) to create the aggregate indices.
4. For each regime, we take the mean of these aggregate indices.

⁴⁴<https://datascience.stackexchange.com/questions/25416/how-word-embedding-work-for-word-similarity>.

⁴⁵See Selivanov et al. (2020). The method is based on word co-occurrence probabilities: the probabilities words occur together normalised by the overall prevalence of the words.

output*	bank rate*	fed rate*	exchange rate*	money growth*
production	rate raised	rate increases	rate exchange	growth money
	discount rate	rate cuts	exchange rates	money supply
	rate reduced	rate increase	fixed exchange	rates money
	base rate	rate hike	floating exchange	monetary growth
	rate cut	rate hikes	sterling exchange	
	benchmark rate	rate policy	dollar exchange	
	bank raised	rate rises		
	rate setting	fed cut		
	bank cut	rate fed		
		fed cut		

TABLE 4.6: Analogies identified by word embedding

Note we do not create a financial press index in this exercise. This is because, as we discussed in section 4.4, *The Wall Street Journal* articles are few before 1920. Instead, we report the results from *The Economist* publication only. Figure 4.11 sets out our concept-specific uncertainty indices; the columns relate to the concepts, the rows are the publication source.

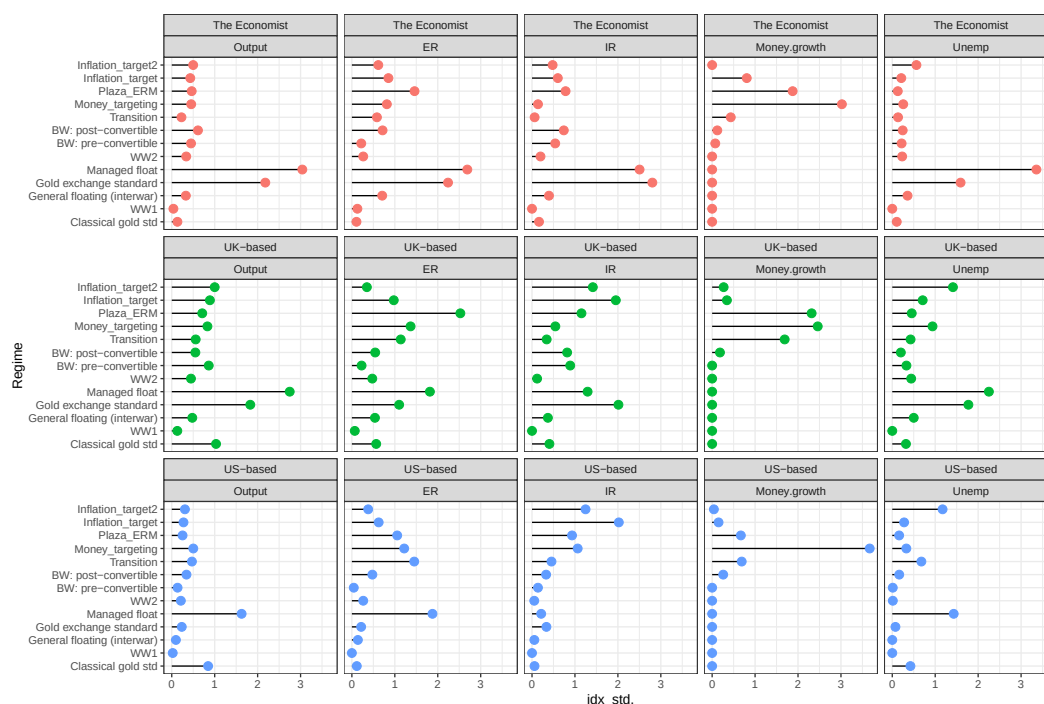


FIGURE 4.11: Index of uncertainty by type by monetary regime

ER: Exchange rate; IR: Interest rate; Unemp: Unemployment

Index is normalised to have an approximately unit standard deviation as per Baker et al. (2016)

Our first economic concept is output. The results are reported in the first column of figure 4.11. All three indices report the managed float regime as the regime with the most output uncertainty (relating to monetary issues); as the period contains the Great Depression and its aftermath, this is no surprise. The gold exchange standard

also registers strongly in the Economist and UK-based newspapers but not in US-based newspapers. This is not surprising given the comparative experiences of the two countries during the period: the United Kingdom struggled to meet domestic objectives as it tried to defend an overvalued exchange rate, while the period was, generally, a time of strong growth in the United States.

The classical gold standard registers significant output uncertainty for the US- and UK-based newspapers. As stated previously, the Baring crisis threatened to push the United Kingdom off the gold standard in 1890-91; this is a case where the monetary regime struggled to cope with an exogenous shock. In the United States, concerns about bimetallism led to gold outflows in 1892-94—these gold outflows would have been disruptive to output.

Post World War 2, the pattern of output uncertainty differs between the United Kingdom and the United States. The UK-based index reports heightened output uncertainty immediately post war. The United Kingdom's output uncertainty reflected a number of factors, including difficulties in coordinating labour bargaining and wage restraint, owing to the fragmented United Kingdom union movement and external liabilities restricting investment. Together, these factors made it hard to defend its exchange rate against the United States and Western Europe countries that were growing faster as they did not have these issues to the same extent (Eichengreen, 2019, p. 118). This points to output uncertainty as a cause of monetary uncertainty (as well as a consequence).

In both the U.S. and U.K. index, output uncertainty increases from the end of Bretton Woods until the 'money targeting' regime. From there, the two series diverge. As with our overall indices, the US-based newspaper output uncertainty index shows a dynamic consistent with the great moderation narrative: a general decline over the 'Plaza and ERM' regime and the first inflation targeting regime. Comparatively, the UK-based newspaper output uncertainty index is broadly stable over the period. All indices record a spike in output uncertainty post the GFC.

Exchange rate uncertainty (see column two of figure 4.11) is generally consistent with what one would expect. Prior to World War Two, US-based newspapers only register heightened exchange rate uncertainty during the managed float era as the debate raged about returning to the gold standard and, then, competitive devaluations were undertaken. UK-based newspapers also register a spike in this era, as well as in the gold-exchange standard era when the United Kingdom struggled to balance its desire to keep an overvalued exchange rate for prestige purposes versus domestic objectives. All three indices show less exchange rate uncertainty through the Bretton Woods period, before it increases again. As with output uncertainty, the dynamics are different through the post-Bretton Woods era. In the United States, it appears that being relatively quick to move to float the exchange rate (barring the Plaza/Louvre period) and free capital flows meant that after some initial uncertainty, exchange rate uncertainty gradually eased off. This is also consistent with Bordo (2021, p.597) who comments [in the 1970s]

[t]he Fed and other central banks believed that foreign exchange markets were inherently unstable and that exchange rate intervention was needed to keep exchange rates close to their fundamentals and to reduce unexplained volatility. . .it was not until the next decade that the Fed and other central banks learned that stable domestic monetary policy geared towards low inflation would reduce instability in nominal exchange rates.

The United Kingdom's ill-fated experiment with the ERM means there is a large spike in the "Plaza ERM" period. In part, the spike reflects the tension between achieving the money growth target and the target band for the pound against the Deutsche Mark. Perhaps the only regime with a surprising result is the general floating (interwar) regime: exchange rates did show volatility throughout the regime, but we record little exchange rate uncertainty on our index.

Money growth uncertainty, as seen in column four of figure 4.11, is also generally consistent with what one would expect. On all indices, there is a smaller, initial spike in the transition regime when money growth targeting was first tried but not pursued with great vigour; the largest spike in the money targeting regime on all indices was when the target was actively pursued. There is a divergence in the indices in the Plaza and Louvre regime. Reflecting the aforementioned tension in the United Kingdom between achieving the money growth target and the target band for the pound against the Deutsche Mark, money growth uncertainty remains elevated in the United Kingdom in the Plaza and ERM period, whereas it falls on the US index as money targeting became more discretionary in nature.

In all three indices, interest rate-related uncertainty has a local spike in the gold exchange standard regime. Perhaps reflecting the use, and then discontinuation of the use, of US monetary policy to try and protect European reserves during the period. Interest rate-related uncertainty is also elevated (relative to other chronologically close regimes) in the managed float regime. This supports the view of Ferderer and Zalewski (1994, abstract) who note 'that the banking crises and collapse of the international gold standard in the early 1930s contributed to the severity of the Great Depression by increasing interest-rate uncertainty'. Post the managed float regime, interest rate uncertainty is fairly low until (at least) the money targeting era, as indicated in column three of figure 4.11. Relative to the other indices, the U.S. index registers a more pronounced increase in interest rate-related uncertainty in the money targeting regime. Whelan (2021) notes the breakdown in previously stable money demand relationships (owing, in part, to financial deregulation) made the money-targeting regime a chaotic period for monetary policy, resulting in extreme volatility in the federal funds rate.

Interest rate-related uncertainty, across all indices post World War Two, however is highest in the inflation targeting regimes. Further comparing money growth uncertainty and interest rate uncertainty over the post-Bretton Woods regimes, we see a general switch in uncertainty about money growth uncertainty to interest rate uncertainty over time. This reflects the change in how monetary policy is conducted, and thought about, over the period. In the money targeting regime, the idea was money growth was an intermediate target that would, in turn, affect inflation (i.e. a monetarist view of inflation); under inflation targeting, interest rates are assumed to affect aggregate demand (in addition to other channels, such as the exchange rate), which in turn affects inflation. This change in emphasis means uncertainty about monetary policy will be expressed in different ways.

In our initial look at types of uncertainty, we look at one final type: uncertainty around unemployment. In the preceding sections, we argued that employment outcomes were subordinated to external goals prior to World War 1. Searching for 'unemployed', 'unemployment' and 'jobless', we see, consistent with the above hypothesis that the terms hardly register until the gold exchange standard in the United Kingdom and the managed float regime in the United States. That unemployment, and related terms, start to register earlier in the United Kingdom than in the United States is consistent with two facts. The first, set out in Eichengreen (1992, p. 9, footnote 11), is there was less pressure in the United States than in other industrial

countries to focus on labour outcomes as the political influence of labour was modest and franchise was limited. Secondly, the recognition during the gold exchange standard that the United Kingdom's desire to return to pre-war parity would come at the expense of unemployment. This quote from *The Times* in 1925 summarises the debate: '[i]t has been suggested that the return to gold now may aggravate the existing grave conditions of unemployment and trade depression, but this point of view wholly ignores the fact that we hope to gain an advantage from returning to the gold standard'.⁴⁶

Following the obvious spike around the Great Depression and its aftermath in all text sources, figure 4.11 shows that until the end of Bretton Woods unemployment does not register. This probably reflects several factors. The first is the post-war settlement in Britain—recognition of labour as a partner in economic decision making and a commitment to full employment (McAloon, 2013, p. 13)—was at its strongest. In the United States, the Kennedy and Johnson administrations sought to reduce poverty, while the Employment Act of 1946 made 'maximum employment' an explicit goal of the Federal government (Applebaum, 2019, p. 12). Secondly, the goal of unemployment was thought to be achievable through Keynesian ideas of aggregate demand management, coupled with the idea that the Phillips curve represented a menu of policy choices with respect to inflation and unemployment. Thus, with both monetary and fiscal policy focused on (and achieving) lower unemployment, there was little uncertainty about unemployment in the newspapers when discussing monetary policy matters.

This all changed by the transition regime, however. The primacy of economic growth and unemployment as policy goals was dethroned by a revolt against Keynesian ideas. Friedman (1968) suggested that the inflation-unemployment tradeoff did not exist, and any attempts to lower unemployment would just result in more inflation. In Britain, which was suffering from high inflation and trade deficits and slow growth, this meant many advocated for a focus on inflation as in this 1976 *Times* article:⁴⁷

'Milton Friedman's 'longer term' has arrived in the United Kingdom. In the short run the political choice appeared to be between a rise in the level of inflation and a rise in unemployment. In the medium term inflation did not remain stable at a higher level; instead it accelerated. In the longer term accelerating inflation has caused an uncontrollable rise in unemployment, as Milton Friedman forecast it would. The arrival of Milton Friedman's 'longer term' is the reason why neo-Keynesian remedies for stimulating the United Kingdom economy out of recession are no longer working in other than the very short term'

In the United States, Weidenbaum (1996, p. 881) describes the change in priorities:

'the Humphrey-Hawkins Act of 1978 formally added the goal of eliminating inflation. The original primary emphasis on 'maximum employment' [in the 1946 Employment Act] which was a legislative compromise to break the deadlock over the more controversial 'full employment' has generally been given a lesser position in federal economic priorities.

⁴⁶'The Gold Standard', *The Times*, May 4, 1925

⁴⁷'Why it may become necessary to prevent the money supply rising too slowly', *The Times*, Monday, November 15, 1976.

This meant (un)employment outcomes began to become subordinate to inflation outcomes and hence unemployment began to be discussed more with monetary policy, as it now became a cost to be borne to bring down inflation (as well as an indicator of inflationary pressures in the economy). Hence unemployment uncertainty is increasing in figure 4.11 post the Bretton Woods regime.

Is uncertainty regime specific?

If we pick a row in figure 4.11 and look across the columns we generally see the topic-specific uncertainty graphs have unique profiles. Output and unemployment uncertainty was highest during the managed float regime, a result of the Great Depression. Exchange rate uncertainty has two local peaks: the interwar period and the 1970s and 1980s. Interest rate uncertainty has been highest under inflation targeting regimes, except in the case of the UK index, where interest rate uncertainty was also high in the interwar period. Money growth uncertainty peaks in the regimes between Bretton Woods and inflation targeting. These unique profiles suggest that the types of uncertainty present are generally not uniform across historical regimes. However, this is only an initial look and, we will provide more evidence in the next section.

4.6 Uncovering the latent topics of uncertainty

The approach set out in section 4.5 is what is termed a dictionary-based approach (Gentzkow et al., 2019). Gentzkow et al. (2019) notes this approach works well when one has strong prior information about how the count of certain terms maps to the outcome of interest. However, they go on to note on page 555:

When there are multiple attributes of interest, and one wishes to resolve or control for interdependencies between these attributes and their effects on language, then one will need to work with a generative model for text. Multinomial logistic regression and its extensions can be applied to such situations, particularly via distributed multinomial regression. Alternatively, for corpora of many unlabeled documents (or when the labels do not tell the whole story that one wishes to investigate), topic modeling is the obvious approach.

Topic modelling is an unsupervised learning method that seeks to identify a set of topics from a set of documents. The idea is certain words are more associated with certain topics and certain topics are more associated with certain documents; in our case the documents are newspaper articles but we continue to use documents to be consistent with the literature. The subject of the topic is researcher-assigned based on the most prevalent words associated with the topic. The most commonly used topic model is the latent Dirichlet allocation model (Blei et al., 2003); its previous application to measuring uncertainty in economics include Larsen (2021) and Ryan (2020b) (which is chapter 5).

However, we use a Structural Topic Model (see Roberts et al., 2016 and Roberts et al., 2019); this is an extension of the latent Dirichlet allocation model.⁴⁸ The Structural Topic Model extends the latent Dirichlet allocation model in two directions: (1) it allows for topics to be correlated; (2) it allows for topic prevalence to be a function of document-level covariates. In our application, we link topic prevalence to the

⁴⁸<https://www.structuraltopicmodel.com/> provides a list of various papers applying the model

monetary regime the article was written in. This allows for a direct statistical test of whether particular monetary regimes result in a statistically significant difference (compared to other regimes) in a topic's prevalence.⁴⁹

With structural topic modelling, the only observable data are the documents' words ($w_{d,n}$). Both the topic proportions in a given document (θ_d , the topic-prevalence vector for each document (newspaper article) d) and the probability a word is associated with a given topic, are unobserved and latent. To uncover the latent elements topic modelling assumes a generative process in how the document is created. It is synthetic and designed to approximate the actual process. The first part of the assumed generative process is most important for us. This is uncovering the different proportions of the K different topics in each document (the topic-prevalence vector for document d). The topic-prevalence vector for document d is drawn from:

$$\theta_d \sim \text{LogisticNormal}(\tau x_d', \Sigma) \quad (4.2)$$

The general variance-covariance matrix, Σ , allows for cross-document correlations in the topic-prevalence vector; hence it is a correlated topic model. x_d is the meta data relating to document d (in our case, the regime the newspaper article/document was written in) and τ is a matrix of coefficients relating covariate values to mean topic-prevalence. Unlike the LDA model, the presence of τ and x_d means meta data plays a role in determining the topic prevalence.⁵⁰

The rest of the assumed generative process, around how the latent distribution of words over topics is recovered, is set out in detail in Roberts et al. (2016) and Roberts et al. (2019) and is less important for our purposes. The algorithm, as implemented in R's STM package (see Roberts et al., 2019), seeks to maximise the posterior likelihood that the observed word counts in particular documents were generated with the assumed generative process.

4.6.1 Choosing the number of topics

Choosing the number of topics, K , for a topic model to generate is always a vexing issue. The authors of the Structural Topic Modelling package we use (R's STM package) and the developers of the structural topic modelling approach, offer the following advice

The most important user input in parametric topic models is the number of topics. There is no right answer to the appropriate number of topics. More topics will give more fine-grained representations of the data at the potential cost of being less precisely estimated. . . . For short corpora focused on very specific subject matter (such as survey experiments) 3-10 topics is a useful starting range. For small corpora (a few hundred to a few thousand) 5-50 topics is a good place to start. Beyond these rough guidelines it is application specific. Previous applications in political science with medium sized corpora (10k to 100k documents) have found 60-100 topics to work well. For larger corpora 100 topics is a useful default size. Of course, your mileage may vary. (p. 65)

Given our corpus size—10,544 articles—the above quote suggests between 60 and 100 topics might be appropriate. We conducted a search over a series of different topic numbers between 60 and 100. Specifically, we estimated the model for

⁴⁹We also add the source of the publication as a covariate as well as the U.S. and U.K.'s annual growth rate when the article was published.

⁵⁰This description draws on Grajzl and Murrell (2019)

eight different numbers of topics, starting at 60 topics, increasing by five topic increments, and finishing at 100 topics. There are a number of statistics on which the optimal number of topics can be selected. The semantic coherence score rewards a model when words that co-occur in documents/articles, also co-occur together in topics. The criticism of this metric is ‘it only addresses whether a topic is internally consistent; it does not, for example, penalize topics that are alike’ (Roberts et al., 2014, p. 7). The practical implication of this is that comparing models by their semantic coherence score means models with fewer topics are likely to be favoured. We also, however, seek topic differentiation or exclusivity; that is, words that have a high probability of being associated with one topic have low probabilities of being associated with other topics (Roberts et al., 2014, p. 7). Thus we seek to find a model with high semantic coherence and exclusivity scores.

We plot the exclusivity and semantic coherence of our models. As we see in figure 4.12, there is a trade off between semantic coherence and exclusivity, which is a common finding. Following Roberts et al. (2014), we select a model on the semantic coherence-exclusivity ‘frontier’. Depending on how one draws the ‘frontier’, either 60, 65, 80 or 85 topics might be the best selection. Given that it is desirable to be near the top, right corner of figure 4.12, we select 80 topics.

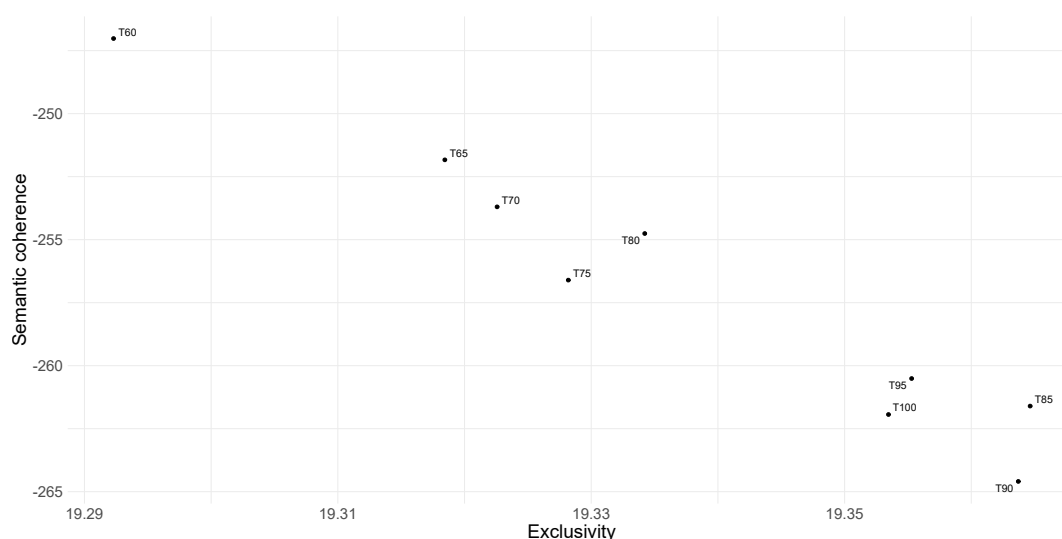


FIGURE 4.12: Exclusivity and semantic coherence for models with selected topic numbers

4.6.2 Results on a ten topic model

Thinking about the results from 80 different topics may be overwhelming initially. For exposition purposes, we begin with a ten-topic model so we can show the estimation output and how to think about the results. The ten-topic model itself has a number of interesting insights.

Figure 4.13 reports two pieces of information on each topic. The left panel of figure 4.13 shows the words most prevalent in each topic for nine out of our ten topics (one did not relate to our task, so we have not reported on it). The right-hand side of figure 4.13 shows, for each topic, estimates of the mean topic prevalence for each monetary regime, and the 95 per cent confidence interval, around this estimate. Looking at the words highly associated with each topic in figure 4.13, we have a topic relating to trade, capital and the price level (topic 1), two topics relating to inflation

(topics 3 and 6), a topic relating to government policy, particularly relating to trade and silver (topic 2), a topic relating to fiscal policy (topic 4) and politics (topic 5), topics relating to bond and stock markets (7 and 8) and the exchange rate (topic 9)

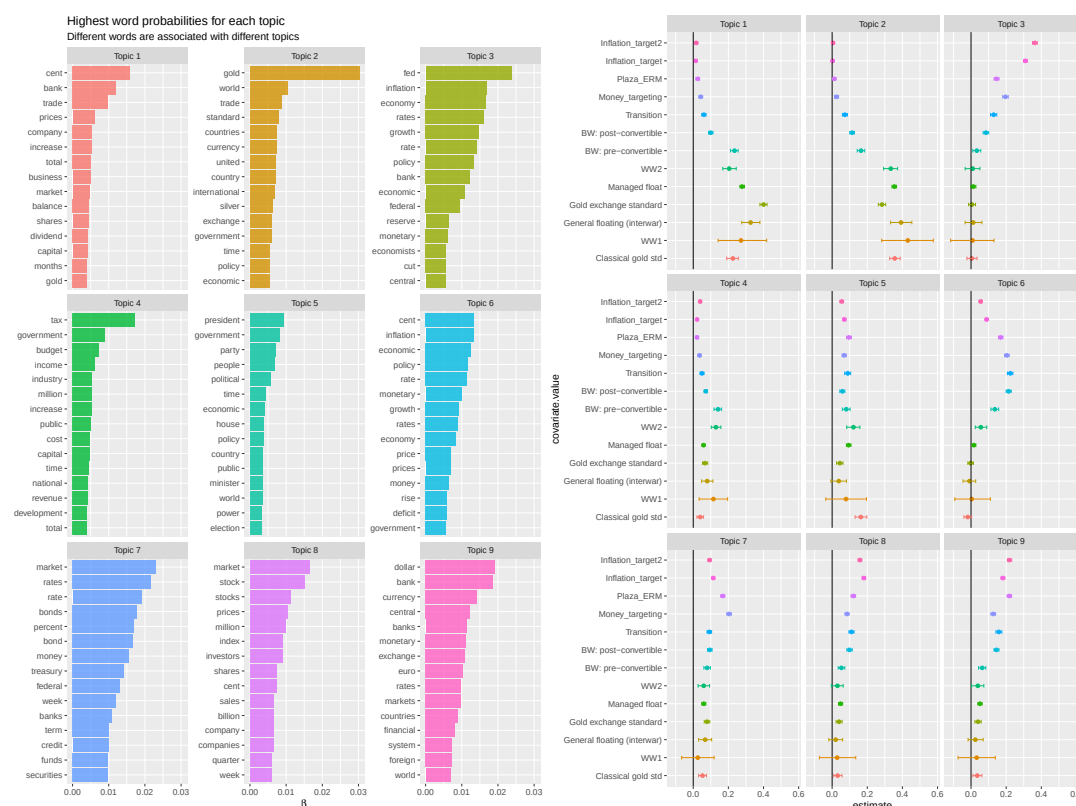


FIGURE 4.13: Results from the ten-topic model

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

Looking at the top left-hand graph in the right-hand panel in figure 4.13, we see the mean prevalence of topic 1 in articles was elevated right through until the Bretton Woods: pre-convertible regime, with its highest value being in the gold-exchange standard regime. As noted above, topic 1 references trade, capital and price levels. Of these three concepts, the price level was probably most associated with uncertainty under the gold standard, owing to its deflationary bias (see section 4.2), and the resulting debates about bimetallism in the United States.

Uncertainty about the concepts included in topic 1 increases once the gold standard ended. This reflects various factors. In section 4.2 we noted trade and capital flows benefited from the stability provided by the gold standard, so a shift to floating rates will have increased uncertainty about trade and capital (as would have the increased barriers to free movement of both). Further, there was a contemporary view that the speculative capital flows were disruptive during the general floating regime (Eichengreen, 2011, p. 47). The deflation in the early 1920s period will also have resulted in uncertainty about the price level. The prevalence of topic 1 increases further when a more flawed replacement of the gold standard, the gold exchange standard, was implemented. This may be a reflection, perhaps, of the comments we made in section 4.2, that with domestic objectives, such as unemployment now on policymakers' radars and sometimes conflicting with the requirements of the gold standard, capital did not always flow in a stabilising direction. Further,

post-1929 trade protectionism and deflation would have generated price level uncertainty. The prevalence of topic 1 remains elevated from the managed float until the Bretton Woods pre-convertible regime—a reflection, perhaps, of the various restrictions on trade and capital through these regimes. This topic, however, is really a combination of several topics (trade, price level, capital), and the fact they have been put together is indicative of the issue that this model has too few topics. Our 80-topic model will allow us to study each of these topics separately and allow more definitive statements.

Topic 2, government policy uncertainty relating to gold, is highest up to and including World War 2; this is not surprising given the role gold played up until then. The topic, like topic 1, is an amalgam of a number of different types of uncertainty: the bimetallism debate ('silver'), debates about returning to the gold standard both post World War 1 and the Great Depression ('currency', 'exchange') and 'trade' (probably reflecting the trade policy responses to countries leaving the gold standard). Again, this shows the drawback of using a small number of topics.

Topic 3 reflects uncertainty relating to monetary policy targeted towards inflation when the interest rate is the instrument; unsurprisingly this is highest during the inflation targeting regimes. Topic 6 is similar, but the higher prevalence of the term 'monetary' and the appearance of 'money' (compared to topic 3) show it relates to uncertainty about using money aggregates as an intermediate target to achieve inflation goals. Unsurprisingly, uncertainty about this topic is highest in the transition regime (when money growth targeting was first tried) and in the money targeting and Plaza/ERM regimes.

Topic 4 is a topic about fiscal policy and aggregates: its prevalence is highest during World War 2 and the pre-convertible Bretton Woods regime; this is hardly surprising as governments (in particular the UK) run up huge amounts of public debt to finance the war and, as *The Economist*, notes '[m]onetary policy was made subservient to debt management and the purpose of the Bank of England became to help finance war' and this continued after the war had finished.⁵¹ Interesting after falling gradually since the pre-convertible Bretton Woods regime, there has been a slight tick up in the prevalence of this topic post-GFC as concerns again arose about inflation owing to central banks monetising budget deficits. Topic 4 is also significant post-World War 1, although the magnitude is smaller. For the United Kingdom, at least, the short-term borrowing undertaken to finance the war created fiscal problems for the Treasury when interest rates increased to assist with getting the sterling re-pegged to the gold standard at pre-war parity.⁵² Given the preceding discussion is not surprising that the UK newspaper covariate is positive and statistically significant for this topic, whereas the US newspaper covariate is not.

Topic 5 shows political uncertainty surrounding monetary policy has been fairly constant through regimes: slightly higher during the classical gold standard as bimetallism was debated, and during World War 2 as the United Kingdom and the United States (read Keynes and White) proposals for the post-war monetary regime were negotiated (see Steil, 2013).

Topic 7—bond market uncertainty—is highest through the 1980s: the heyday of the bond market vigilante; we will discuss this in more detail later. Topic 8—stock market uncertainty—is highest in the inflation targeting regimes, a reflection of the market crash during the GFC. It is surprising, however, that the crash of 1929 does not register a spike in uncertainty during the gold exchange standard regime.

⁵¹'Free Exchange: War and Peace', *The Economist*, July 24 2021.

⁵²*Ibid.*

Topic 9 shows the prevalence of exchange rate uncertainty remains low until the post-convertible Bretton Woods regime. The uncertainty in the post-convertible regime is probably a reflection the dollar glut associated with the U.S.'s loose monetary policy meaning there were uncertainty about the regime's sustainability (as expressed by the Triffin dilemma). These fears, in conjunction with the promotion of floating exchange rates in academic circles we cited earlier, contributed to uncertainty as some worried about the prospect of a floating exchange rate ('the fear of floating'); as noted earlier floating had a bad reputation after the study of Nurkse (1944) of the interwar floating period. Finally, the post Bretton Woods era sees elevated exchange rate uncertainty as the U.S. dollar and pound floated (either in a freely or managed sense). Exchange rate uncertainty remains elevated through the initial two post-Bretton Woods floating regimes (the transition and money targeting regime), before increasing again during the Plaza and ERM period. As noted earlier, just prior to joining the ERM was a time of uncertainty in the United Kingdom as exchange rate and money targeting goals clashed. Further, exchange rate uncertainty will have also been high in 1992, when the pound was attacked before the United Kingdom eventually left the ERM.

4.6.3 Results from the full model

We now turn to results from our 80-topic model. In order to organise our results, we (loosely) collect our topics into themes. If a topic fits two themes, we have made a decision on which theme to allocate it to.

Prices and inflation

We have nine topics that feature the words 'price' or 'inflation' in the topic's top 20 most prevalent words. These topics are set out in figure 4.14 below.

Topic 11 refers to uncertainty about oil prices, which has been significant post Bretton Woods and it was highly prevalent in the 1970s as oil prices surged in two oil shocks. These oil shocks made the conduct of monetary policy extremely difficult for the United States as being a classic supply shock, inflation and unemployment outcomes suggested different paths for monetary conditions. For the United Kingdom, as discussed earlier, instability in oil prices had implications for its currency once oil was found in the North Sea. Topic 37 picks up on uncertainty about house prices and is significant during the inflation targeting eras. In the main, this is likely to reflect the uncertainty created for monetary policy from the subprime mortgage market collapse. However, even before the GFC, the housing market was a source of uncertainty. Irwin (2013, p. 104) notes even in 2005, the debates at the Federal Reserve behind closed doors indicate 'how challenging it was for central bankers to convert their sense that something was wrong with housing into concrete policy'. Further, post-GFC, the advent of abundant liquidity from quantitative easing has led to an inflation of asset prices, including house prices.

Topic 78 reflects uncertainty about price and wage controls. The uncertainty about this topic is highest during the Bretton Woods regimes and the transition and money targeting regimes, with the highest amount of uncertainty being in the transition regime. Statutory wage and price controls were an institutional change: they abandoned a convention that inflation could be controlled via aggregate demand for statutory limits on price and wage growth. Nixon imposed mandatory wage and price controls, in various phases, over the period August 1971 to April 1974. Meanwhile in the United Kingdom, November 1972 saw the introduction of a three-stage

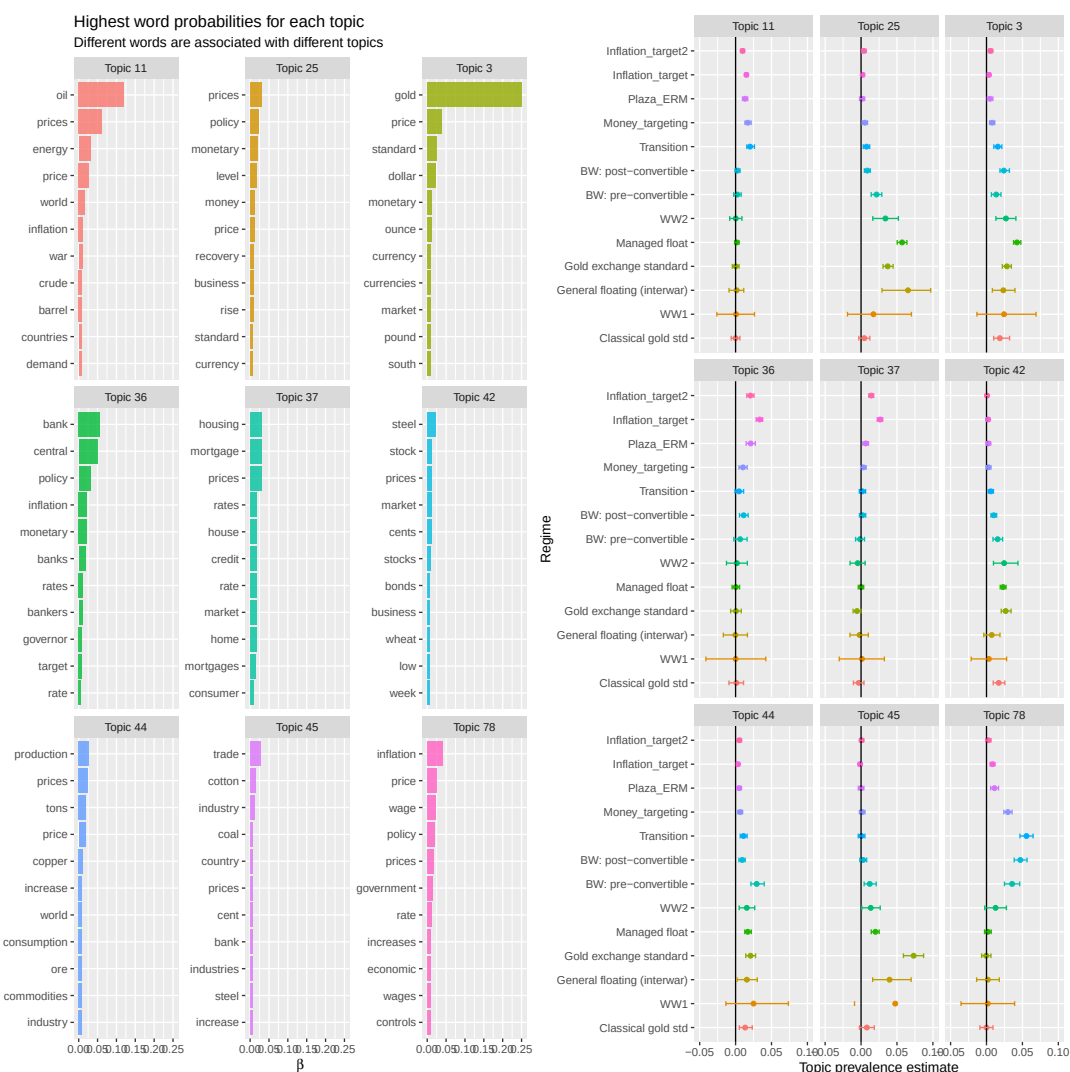


FIGURE 4.14: Topics to do with prices or inflation

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

statutory program: a three month total freeze and then two phases of mandated wage growth. A bitter disagreement between the coal miners and the government saw this end and the government voted out (Parkin & Darby, 1976, p. 7). However, a new government enacted mandated wage growth restrictions in 1975. Given all these controls were enacted in the transition regime, it is not surprising that uncertainty about wage and price controls is highest in this regime.

The aforementioned controls, however, were not the United Kingdom's first post-World War 2 experience of controls: there were various episodes of voluntary controls from 1948 to mid-1966, with statutory total wage freezes imposed from July to December 1966 and a subsequent period (until mid-1967, and then from 1968 to 1970) of 'severe restraint' (Parkin & Darby, 1976, p. 7). Hence we observe uncertainty about controls in the Bretton Woods regime.

Our finding of a low level of price level uncertainty (see topic 25) in the classical gold standard era but rising during the general floating regime is consistent with Cogley et al. (2015) who found price-level uncertainty had a trough in the United

Kingdom in 1890 but reached a peak in 1920. The U.S. study by Cogley and Sargent (2015) found a trough in 1904 and a peak in 1921.⁵³ The re-linking of many of the world's currencies to gold during the gold-exchange standard regime—that is, the reestablishment of gold as a nominal anchor—sees a slight fall in price level uncertainty. Price level uncertainty, however, then increases again once the United Kingdom and the United States go off gold in the managed float era. This finding is different from Cogley et al. (2015) and Cogley and Sargent (2015)—they find price level uncertainty is elevated during the managed floating regime but less so than in the immediate post-World War 1 period. The different findings probably reflect the data sources used. Their price level data display more variability in the 1920-25 period, making it harder to forecast. Our data, text about the price level, captures more the strong debate in the managed float regime, about what should be done to deal with the deflation (if any thing)? Particularly, should the United States return to the gold standard or not? This contrasts with the situation post-World War 1 where it was almost taken as given that a return to the gold standard was the right thing to do, and thus, the appropriate monetary regime was without real question.

Our finding that price level uncertainty is higher during the gold exchange standard compared with the gold standard—two regimes which shared many institutional similarities—indicates the environment in which the gold-exchange standard was operating was less conducive to its operation and stabilising prices. As noted earlier, speculative currency flows no longer flowed in stabilising directions as investors had more reason to believe that international objectives—preservation of the gold standard—might not triumph against domestic ones. Second, gold was now in the hands of the central banks of the US and France, rather than the United Kingdom. Bernanke and James (1991) note, in contrast to the Bank of England, which tried to minimise sustained gold inflows and outflows for commercial reasons (gold did not pay interest, so they sought low reserves), the Federal Reserve and the Banque de France did not seek profits and thus were comfortable accumulating gold: this put sand in the price-specie flow mechanism designed to facilitate a balance of payments adjustment.⁵⁴ Further, the war had left several legacies: debt (and reparations) and overcapacity in agriculture and heavy industry but under-capacity in others. Bernanke and James (1991, p. 39) notes under the gold-exchange standard, because of these problems (and others) ‘even a relatively minor deflationary impulse might have had significant repercussions’.

Topic 36 picks up uncertainty regarding *inflation* and meeting a *target*. Unsurprisingly, it is idiosyncratic to the inflation targeting regimes. Further, the topic is slightly more prevalent in U.K. publications (0.038 vs 0.029) as the United Kingdom have been publicly inflation targeting for longer. Topic 3—uncertainty regarding gold as relating to prices and currencies—has two local peaks: once during the interwar regimes and once in the Bretton Woods post-convertible regime. The peak during the latter regime is a reflection of uncertainty created by divergences in the market and official prices of gold during the Bretton Woods post-convertible regime. The gold pool was designed to deal with these divergences but when it failed in

⁵³Both of these papers employ a non-linear state space model, where price-level uncertainty is measured as the conditional volatilities (standard deviation) of cumulative 5-year and 10-year inflation.

⁵⁴Further, Bernanke and James (1991)[p. 39] note Banque de France was prohibited from conducting open market operations, meaning the gold inflows it received were not translated into increased money supply. This failure to inflate meant France continued to attract gold and therefore imposed deflation on the rest of the world (Bernanke & James, 1991, p. 39)

1968, it resulted in a two-tier market for gold and instability in the gold and financial markets in general.⁵⁵ The peak during the general floating/ gold-exchange standard/managed float regimes reflects the uncertainty about whether currencies would return to gold (general floating), remain on gold (end of the gold-exchange standard) and then, once they were off gold, if they would return (managed float).

Topics 42, 44 and 45 show uncertainty about commodity prices. These topics are elevated during the gold-exchange standard and managed float regimes which is consistent with Erten and Ocampo (2013) who show, in their figure one, that the period was a period of unusual volatility in commodity prices. So what explains the link of commodity price uncertainty to the monetary regimes during this period? Sumner (1992) argues, post 1929, the perceived threats to international monetary cooperation from, one, trade protectionism (the Smoot-Hawley Act) and, two, the rise of the Nazi party were reflected in commodity and stock prices. Therefore any uncertainty surrounding international monetary cooperation from the aforementioned sources in the interwar period, particularly post-1929, is likely to have generated commodity price uncertainty. Topic 45 is most prevalent in the gold exchange standard regime. Ahamed (2009, p.235) notes the increase in the exchange rate brought about by the United Kingdom's return to the gold standard 'began taking its toll on the staple industries of coal, steel, and shipbuilding' as prices were squeezed. Note 'coal' and 'steel' are the fourth and ninth most prevalent words in topic 45. Topic 45 is also elevated in the general floating regime. Persons (1922) notes the role played by an increase in rediscount rates by federal reserve banks in the collapse in cotton prices post the World War 1 boom. Cotton is the second most prevalent word in topic 45.

Balance of payments

Next, we move on to topics about trade/ balance of payments. Figure 4.15 identifies these topics and their most prevalent words.

Consistent with the comments of Obstfeld and Taylor (2004) cited earlier, the classical gold standard seems to have benefited trade with only one topic, a topic relating to shipping (topic 66), showing any noticeable prevalence during the period. The interwar period (topics 29, 38, 45, 53 and 66) exhibits considerable trade uncertainty. As noted earlier, trade benefited from fixed exchange rates during the classical gold standard and the new experience of floating exchange rates (and thus fluctuating export and import prices) during the general floating regime would have added to uncertainty. Further, in the aftermath of the 1929 stock market crash, many countries resorted to trade policy measures to maintain competitiveness— generating trade uncertainty.

The sterling's immediate post-war troubles are captured by topics 26 and 41. Topic 26 captures the 1949 devaluation. The 1949 devaluation had its roots, in part, owing to trade developments. We have outlined how the crisis played out earlier, noting that sterling area countries, in a bid to fund their imports, in the midst of lower export demand due to a U.S. recession, drew down their sterling balances. Further, prior to this, the United Kingdom had been unable to generate export revenues to pay down its debts as European countries maintained high tariffs and quantitative restrictions (Eichengreen, 2019, p. 97). Topic 41 captures the 1967 devaluation. Although not immediately obvious by the words reported in figure 4.15, the fact that only the U.K. (and Financial Press) prevalence estimates are significant lead

⁵⁵<https://www.gold.org/about-gold/history-of-gold/bretton-woods-system>; accessed 20 December 2020.

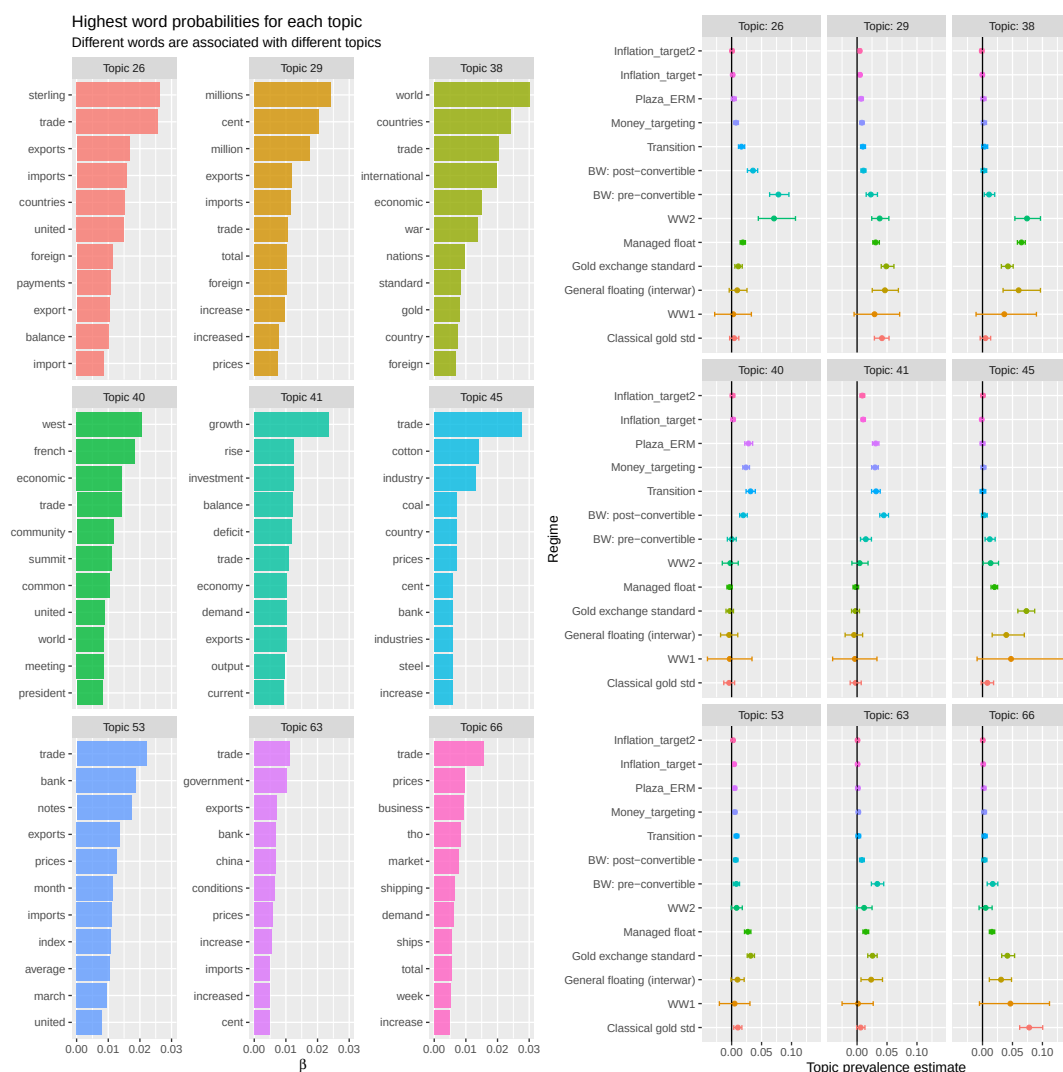


FIGURE 4.15: Balance of payments-related topics

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

us to this conclusion (U.K. estimate: 0.028; U.S. estimate: -0.001). In explaining the devaluation at the time, *Time* magazine put it down to (my italics added):⁵⁶

For most of the postwar years, Britain's productivity has failed to keep pace with that of its competitors. Among the major industrial nations, Britain since 1951 has had the slowest rise in productivity, the lowest rate of *investment* in private enterprise and the largest rise in its *export* prices. . . Britain's pretensions to playing the role of a great power added to her *trade*-imbalance difficulties.

Note the overlap between the italicised words in this quote and words associated with topic 41. Further, once agreed, the devaluation of the pound was presented as an opportunity to boost exports and lower the trade deficit.

⁵⁶As quoted in: '50 Years Ago This Week: Britain's Money Crisis', available at <https://time.com/5021394/1967-british-pound-devaluation/> [accessed 9/12/2021].

Currencies and bimetallism

In figure 4.16, topic 24—‘sterling’, ‘exchange’—picks up the uncertainty generated from the sterling rejoining the gold standard at an overvalued rate and then devaluing in 1931 after pressure on the Bank of England’s reserves (Eichengreen, 2019, p. 45). We see the word ‘french’ is highly prevalent in this topic. This reflects three developments. One is the large gold inflows to France, at the expense of the United Kingdom (amongst others), in the latter half of the 1920s. Accominotti (2009, p. 351) notes: ‘[b]efore the 1931 sterling crisis, France was criticised for hoarding gold, causing the pound’s difficulties on the exchange market’. Ahamed (2009, p.433) claims a myth persisted for many years that sales of the pound by the French had set out the events leading to the pound devaluation.⁵⁷

Topic 20 is elevated during the managed float regime and World War 2 (as well as the gold exchange regime). ‘China’ and ‘silver’ are prevalent in this topic. Friedman (1992) notes, following the 1929 crash, the Chinese had benefited from being on their silver standard to this point as their currency had depreciated against other currencies, increasing the local price of their exports. However, once the United States and the United Kingdom left the gold standard, China’s balance of payments deteriorated as the Chinese currency appreciated. Steil (2013) and Friedman (1992) note the 1934 Silver Purchase Act—an act which compelled the Treasury to buy silver to increase its price—further hurt China by appreciating their currency, resulting in major deflation. China left the silver standard in 1934. Friedman (1992) argues that being off the silver brought forward the need for inflationary monetary creation to finance the war against Japan and the communists.

Topic 74 picks up the uncertainty surrounding the United Kingdom joining the ERM in 1990 (and having to subvert its domestic monetary policy goals to achieve the desired rate against the Deutsche Mark) and the uncertainty caused by its exit from the ERM owing to the speculative attack on the pound.

Moving on to other currencies, we observe two periods of uncertainty about the Euro. One, covering the period 1993 to 2007, reflects its establishment (and a name proposed) and its introduction (see topic 32); Yarbrough and Yarbrough (2003, p. 623) note the political and economic uncertainty generated by the ratification of the Maastricht Treaty during the 1990s. The second period reflects the European debt crisis (topic 51) and its effects on the Euro.

The uncertainty about the prospects for the dollar and the Deutsche Mark during the Plaza Accord era is also captured (topic 62). Further, Germany’s deflation, as the result of the bond financing of its reunification, was the shock that led to the collapse of the EMS (Bordo, 1995). Topic 14, a topic about the Yen, is elevated during the, and in the post, Plaza accord. This topic captures, in part, one, the effect on Japan from being forced to revalue its currency as part of the Plaza Accord and, thus, lose its export competitiveness, and, two, the intervention by the U.S. and Japanese central banks to boost the Yen in 1998 — which was declining against the dollar as its economy faced problems (Yarbrough & Yarbrough, 2003). The topic might more broadly capture the general uncertainty about the prospects for the Yen as the Japanese economy stagnated beyond the early 1990s, unable to be revitalised by monetary policy as interest rates were at the zero lower bound.

The other topic that was highly prevalent in the inflation targeting era is topic 9: on Chinese currency affairs. China has challenged the primacy of the U.S. dollar in world monetary affairs since the turn of the 21st century. And there have been

⁵⁷He also notes the myth was untrue; he claims the Banque de France had not sold any of their pound deposits.

several events that may have generated uncertainty from the point of view of the United States. These events include: China moving to a managed float in 2005, and a 2010 pledge to allow the Renminbi to trade more freely against the U.S. dollar (although still in a band). Further in 2009, the People's Bank of China Governor prompted the creation of an international reserve currency (the SDR) to reduce the world's reliance on the U.S. dollar. This, and the Governor's proposal for the SDR valuation to be expanded to include all major currencies, signalled an increased use of the Renminbi internationally (Schenk, 2011, p. 165).

One thing is noticeable looking at all the topics regarding currencies and exchange rates collectively (all topics in figure 4.16 except 20, 54 and 68): the lack of uncertainty about currency in the Bretton Woods era. Exchange rate uncertainty appears confined to two periods: the interwar period and the post-Bretton Woods years with their floating exchange rates. Thus, exchange rate uncertainty appears to be regime specific.

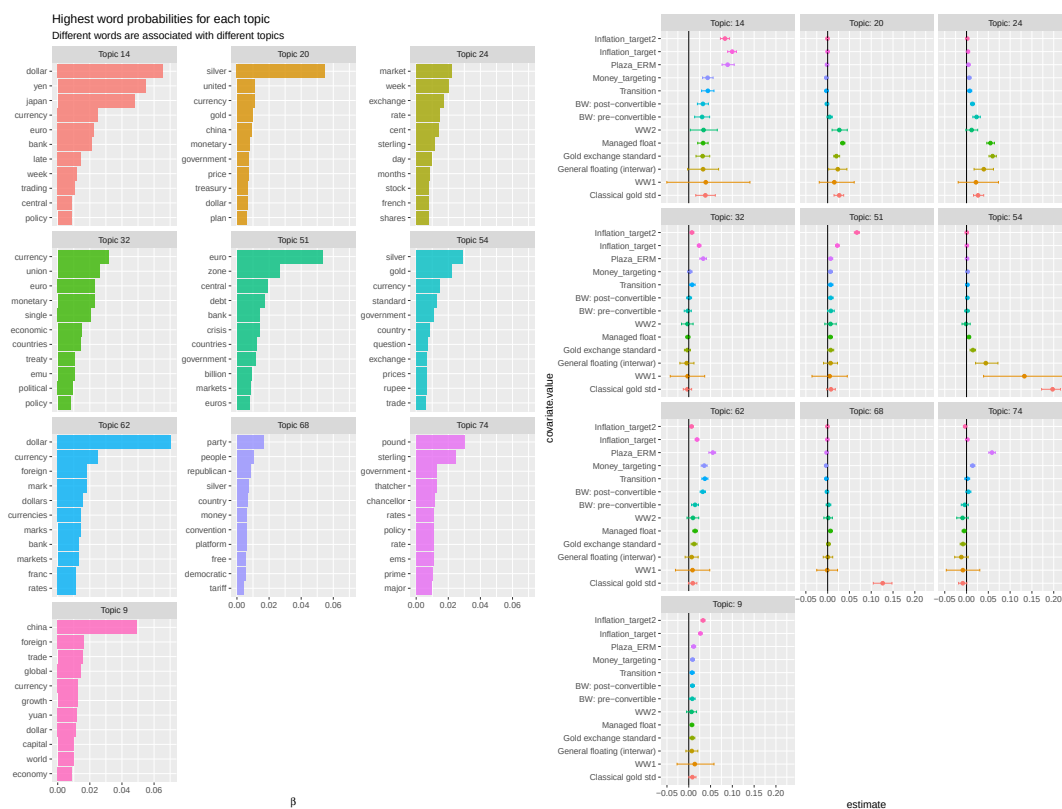


FIGURE 4.16: Topics relating to currencies and bimetallism

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

Topics 20, 54 and 68 relate to bimetallism. Looking at figure 4.16, two topics in this group contain the words 'gold' and 'silver' (topics 20 and 54), and topic 68 refers to silver—all are highly prevalent during the classical gold standard regime. This suggests that the bimetallism debate that raged in the US at the turn of the 19th century was a source of uncertainty.

Government and fiscal policy

Figure 4.17 shows uncertainty about fiscal policy and aggregates, government and politics. In the Bretton Woods regimes, topics 19, 43 and 67 are highly prevalent. Topics 19 and 67 are highly prevalent in the pre-convertible Bretton Woods era (and World War 2), reflecting uncertainty surrounding how to pay for war debts, as we discussed earlier. Topic 43 is more prevalent in the four regimes from the post-convertible Bretton Woods regime to the money targeting regime. Bretton Woods was the height of the fiscal dominance era—an era when the influence of the writings of Keynes meant fiscal policy was viewed as superior (or at least on par) to monetary policy for the purposes of macro-stabilisation, as this quote from a Bank of England article written in the period (BoE, 1969) indicates:

In general, it remains the authorities' belief that fiscal and monetary policy work - and must work - jointly. Without monetary restraint, fiscal restraint will either be largely ineffective or - if it is made effective in a conjunctural sense - is likely to have damaging longer-run effects on incentives or the provision of public services. Likewise with a large public sector deficit, monetary restraint to be effective at all will have to be so severe as to risk drastic and unpredictable consequences for the whole financial system. The lesson is perhaps not to expect too much of any one arm of economic policy, especially for 'fine tuning'. As we learn more we should be able to refine our techniques and predict better their effects; but, at least in the present state of our knowledge, it looks unlikely that we shall ever be able to rely primarily on monetary policy for short-term stabilisation of the economy and the balance of payments.

The faith in fiscal policy meant Bretton Woods was a period of big government programmes: John F. Kennedy's new frontier (1961-63) and Lyndon B. Johnson's great society (1964-65), for example. As noted above, Topic 43 is also highly prevalent during the money targeting regime, reflecting two historical events: one, the use in the United Kingdom of the Public Sector Borrowing Requirement, in conjunction with interest rates, to target money growth and, two, Reagan's tax cuts and deficits. The topic prevalence estimates are both significant for U.S.- and U.K.-based newspapers, indicating that this topic captures both of these developments. The estimate of the topic prevalence in U.S.-based newspapers is more than three times the estimate of the topic prevalence in U.K.-based newspapers, indicating it might be more about Reagan's fiscal policy. The link between Reagan's fiscal situation and the monetary regime is the large increase in interest rates under Volcker would have increased the government's debt servicing costs, which would have generated uncertainty about the budget deficits.

Topic 50 captures the uncertainty around the fiscal policy post-GFC. In the presence of the zero-lower bound, fiscal policy was called on to help stimulate the economy, for example, the American Recovery and Reinvestment Act of 2009. Further, rising government debt levels also lead to debate between those wanting austerity to bring debt down and those wanting fiscal policy to act as a stimulus: in the United States this manifested itself in 2011 and 2013 debt ceiling crises; in the United Kingdom, Mervyn King, the Bank of England governor, was a proponent of austerity and this resulted in tensions in the monetary policy committee:⁵⁸ '[a] rift emerged at

⁵⁸Kollewe, J. 'Mervyn King's support for cuts 'excessively political' – MPC member', *The Guardian*, 25 November 2010.

the heart of the Bank of England today when a member of its monetary policy committee claimed that governor Mervyn King's support for the government's austerity drive earlier this year had been excessively political.'

It could be said he violated the convention that modern central bankers are not partisan.

Topics 5 and 64 pick up general political uncertainty, which is more-or-less constant across regimes. This indicates monetary matters have always been a source of political uncertainty. Topic 79 identifies a period of heightened political uncertainty: the managed float. This may reflect Roosevelt's response to the Great Depression. Roosevelt made a number of key decisions in the aftermath of the Great Depression: not to return to gold, to revalue gold in 1934 and not sterilise the inflows of gold (Romer, 1990). The decision over whether or not to return to gold, in particular, lead to a number of political battles both in and outside the administration (see Rauchway, 2015).

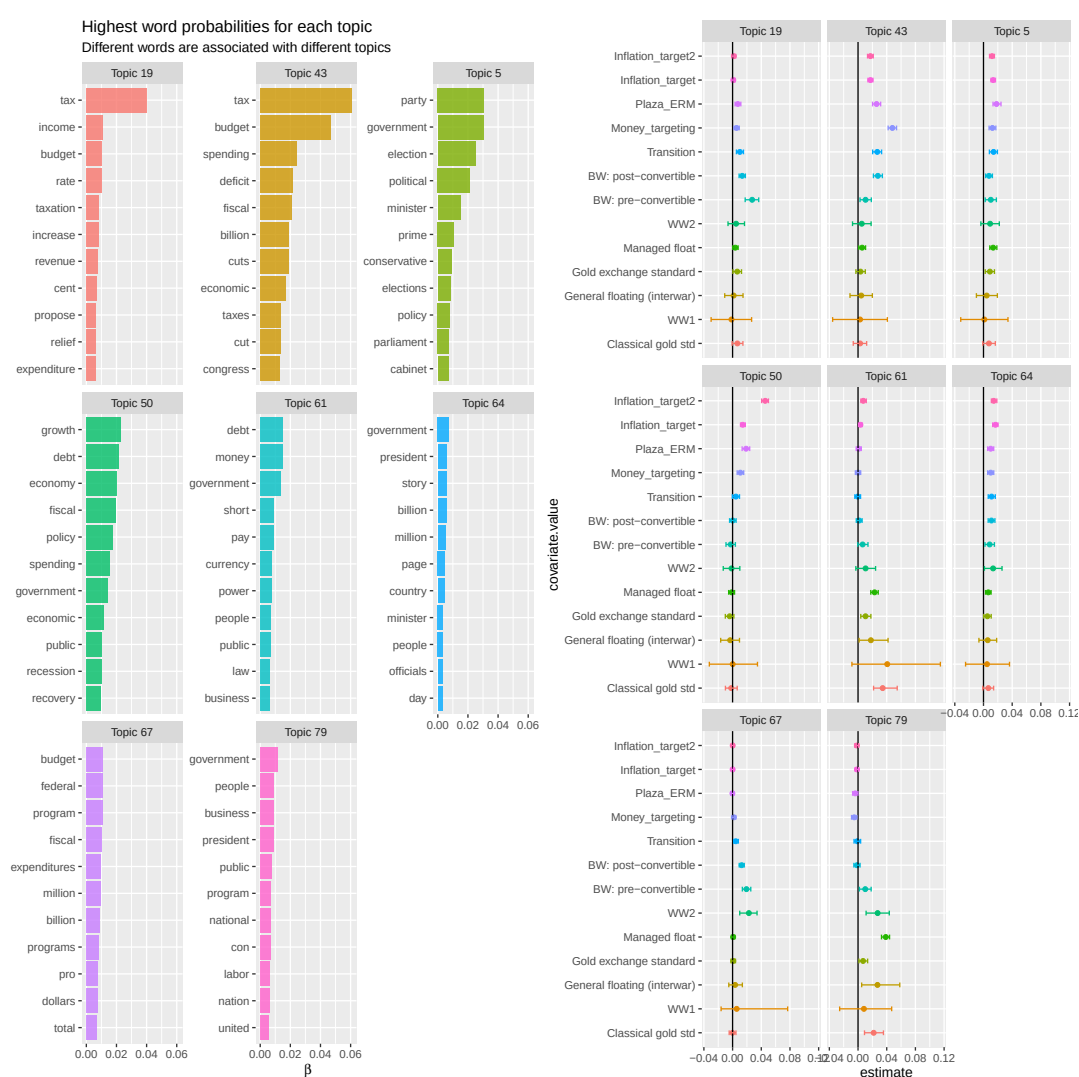


FIGURE 4.17: Topics of uncertainty relating to government and fiscal policy

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

Interest rates, money and banks

Turning to figure 4.18, topic 22 shows uncertainty about the money supply; this is most prevalent using in the monetary targeting regime (and to a lesser extent in the transition regime and the Plaza and ERM regimes: regimes where a form of money targeting was happening but with more discretion). Earlier, when discussing topic 36 in figure 4.14, we noted that uncertainty about inflation targets was highest in the inflation targeting regimes. There are clear parallels with topic 22, in that whatever the target of the day is, the target will be associated with uncertainty about whether monetary policy can achieve it.

A destabilising view of capital flows was forefront in the minds of the architects of the Bretton Woods regime, which contained measures to control capital movements. Topic 10 appears to pick up some of the uncertainty around capital flows/controls during the Bretton Woods regime and its development. The topic is particularly prevalent during the pre-convertible regime, where of the two Bretton Woods regimes, capital restrictions were more prevalent.

Topic 2—‘fed’, ‘financial’, ‘markets’—picks up the uncertainty about the financial system in the wake of the GFC and may capture some of the uncertainty created for monetary policy by central banks also having a financial stability mandate, which we discussed in section 4.2.

Topic 17 picks up the uncertainty around banks, gold and reserves in the World War 1 and the interwar period. Ahamed (2009, p. 31) notes, on the eve of World War 1, there were concerns over the adequacy of the Bank of England’s gold reserves as commercial banks withdrew gold from their Bank of England accounts. This led the Bank of England to raise its interest rate to ‘an unprecedented 10 per cent’. Further, Ahamed (2009, p. 72) notes there was a view in 1914 that gold reserves would ‘determine the intensity...and probable duration of the war’. In the 1920s, concern arose about the adequacy of Europe’s gold reserves and the 1927 ‘Long Island’ meeting was devoted to ‘finding ways to encourage the flow of gold from the United States to Europe’ (Ahamed, 2009, p. 297). This ultimately led to the Federal Reserve cutting interest rates. Finally, July 1931 saw the Bank of England lose half its gold reserves, it responded by raising interest rates (Ahamed, 2009, p. 424). More gold losses followed and the pound was eventually taken off the gold standard. Ahamed (2009, p. 438) also recalls the Federal Reserve was forced to *increase* its interest rate in October 1931 to maintain its gold reserves, despite the large drops in economic output, to ensure it had enough gold to back its currency. The final event of relevance during the managed float regime is, as discussed in section 4.4, the 1936–37 doubling of reserve requirements by the Federal Reserve for member banks.

Two periods of bond market uncertainty are identified. The first period is in the 1980s when so-called bond vigilantes would sell treasury bonds in countries where policy (including monetary policy) was considered inflationary (see topics 7 and 70). The second period is in the aftermath of the GFC and relates to quantitative easing (and its tapering) (see topic 34). Quantitative easing caused uncertainty in a number of ways. The first relates to the inflationary consequences as some commentators promoted the idea that central banks were ‘printing money’ and invoked memories of certain hyperinflation episodes. The second source of uncertainty was the effects on the bond market once central bank purchases ceased (the taper tantrum in 2013, which resulted in a spike in yields). Further, there were concerns that once the ECB started bond buying, they were violating the spirit of the Maastricht Treaty (Irwin, 2013, p. 217). The ECB avoided breaking the rules of the Treaty on a technicality by buying the bonds on the secondary market, not directly from governments.

Topic 80 reflects the fallout from Volcker's policies on the savings and loan industry. Volcker's high interest rates were problematic for the savings and loan industry: money was attracted away from the industry, as the interest rates savings and loan organisations could pay were mandated by government at a rate lower than market interest rates. In order to save the industry, a number of regulatory and legislative changes were enacted. These, along with a government guarantee via the Federal Savings and Loan Insurance Corporation, resulted in rapid growth and risky behaviour in the industry. Once the industry collapsed, it ended an industry that had once been a prime source of home mortgages.⁵⁹

Topic 65 and 77 capture uncertainty about short-term interest rates, and both are most prevalent in the inflation targeting era. This is consistent with our findings in section 4.5. It reflects a relatively new convention in the conduct of monetary policy: open mouth operations (see Guthrie & Wright, 2000) which involves the use of announcements to influence interest rates of all maturities. Thus market participants, and those commenting on markets, spend time interpreting what is said by central bankers and how it will affect market interest rates. What is interesting about these two topics is they are not highly prevalent during the managed float regime. In section 4.5 interest rate uncertainty was high during the managed float regime (and this was consistent with Ferderer & Zalewski, 1994); we do not observe this here. Reconciling the different results is a topic for future research.

Finally, topic 52 captures uncertainty about the Federal Reserve and the White House interactions in the 1970s. President Nixon and Arthur Burns, the Federal Reserve chair, had a rocky relationship. Further, the president successfully persuaded Burns into cutting interest rates to boost Nixon's re-election chances in the 1973 election. Bill Miller, who followed Burns, also had tensions with the (Carter) administration since many of the administration's key advisors were unhappy that he did not raise interest rates to fight inflation in the period.⁶⁰

Other interesting topics

Figure 4.19 outlines some other topics not already discussed. Topics 31 and 75 pick up the uncertainty coming from both wars. Wars create several sources of uncertainty for a monetary regime, including reserve adequacy. For example, as discussed earlier, with the first World War on the horizon, the Bank of England experienced huge withdrawals from its gold reserves from commercial bankers, creating concerns about the adequacy of the Bank's reserves (Ahamed, 2009, p.31). Another source of uncertainty is inflation. The money supply is expanded to finance purchases, and this is inflationary. The British money supply doubled during World War 1, as did the U.S. money supply, although the increase in the U.S. money supply reflected an influx of gold rather than inflationary financing (Ahamed, 2009, p.100). The United States in World War 2 experienced inflation as the monetary base increased when, one, bonds were brought to keep yields low and, two, gold flowed from the United Kingdom to pay for supplies (Sanches, 2013),⁶¹. The United Kingdom also adopted a cheap money policy during World War 2, and this too was inflationary. A further source of uncertainty emerged in this war and its aftermath.

⁵⁹This paragraph heavily draws on <https://www.federalreservehistory.org/essays/savings-and-loan-crisis> and <https://www.investopedia.com/terms/f/federal-savings-and-loan-insurance-corporation-fslic.asp>; both accessed 10/12/2021.

⁶⁰<https://web.archive.org/web/20101015213958/http://www.time.com/time/magazine/article/0,9171,723928,00.html>; [accessed 10/12/21]

⁶¹<https://www.federalreservehistory.org/essays/wwii-and-its-aftermath>

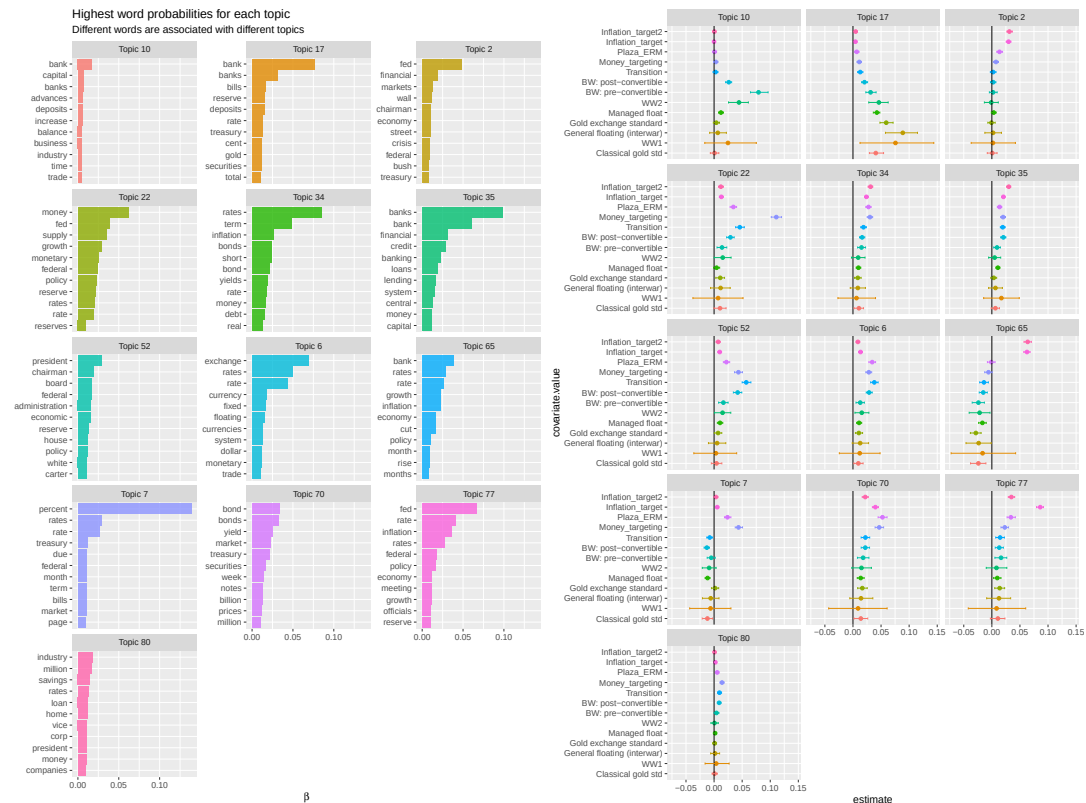


FIGURE 4.18: Interest rates and other related topics

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

Monetary policy was subverted to manage debt costs at the expense of other objectives.

Topic 76, relating to jobs and unemployment, only becomes significant post-Bretton Woods. This provides support to the idea developed earlier: pre-World War 1 unemployment did not register as a policy goal and, thus, was not a source of uncertainty. Post-World War, it was the primary goal of policy, and as there was success in achieving low unemployment, it again was a not source of uncertainty. Only in the post-Bretton Woods era where the focus on monetary policy shifted to inflation, has uncertainty about unemployment been generated. There are two reasons for this. Firstly, the focus on reducing high inflation in the 1970s and 80s came with the cost of generating unemployment, a trade off policy makers were willing to make. Two, following Friedman's 1968 (Friedman, 1968) address, the idea arose of unemployment relative to some level (the non-accelerating inflation rate of unemployment) as a measure of inflationary stance and, thus, the appropriate settings of monetary policy. As such, uncertainty around the prospects for unemployment contributed to uncertainty around the appropriateness of monetary policy. Like topics 65 and 77, our findings here contrast with our earlier search for 'unemployment' and related terms in section 4.5. Unemployment uncertainty, as calculated in section 4.5, was significant during the managed float regime; the prevalence of topic 76, in contrast, is not significant in the managed float regime. This represents another puzzle worthy of investigation.

There are three topics (8, 58, 59) relating to the stock market, and each is elevated around the three big stock market crashes of the last 120 years: 1929 (topic 58), 1987

(topic 8) and the Global Financial Crisis (topic 59). Further, although the specific event is not in our sample period, the 1873 financial panic caused by the collapse of Northern Pacific Railroad and the banking house of Jay Cooke and Company (DeLong et al., 1999, p. 266), set in place the so-named ‘long depression’, the effects of which were still being felt in the 1890s. It appears topic 69 picks up the uncertainty associated with this event.

Topic 48—“economics”, “policy”, “professor”—relates to uncertainty arising from the economics discipline on policy and this uncertainty is at its zenith during Bretton Woods and the transition. As we have discussed earlier, two big policy proposals were put forward and eventually adopted during this era: floating exchange rates and the switch of focus on monetary policy from unemployment to inflation. As discussed, there was a ‘fear of floating’, while a shift in focus away from unemployment might have been daunting for some.

Topic 57 notes uncertainty about ‘conference’, ‘united’ (states), ‘French’ and ‘president’ and its prevalence is high during three interwar regimes. Regarding the high prevalence in the general floating and gold exchange standard regimes, it may reflect the uncertainty stemming from the Paris Peace Conference in 1919-20, specifically, one, how the debt obligations were going to be met and, two, the consequences of the breakdown in international cooperation.

Regarding the managed float regime, topic 57’s high prevalence may reflect the tensions over exchange rate depreciation via exchange funds by the United Kingdom and the United States in the early 1930s. The matter was resolved in 1936 by the Tripartite Agreement between the United States, France and the United Kingdom, this allowed France to depreciate without responses from the other two countries (Eichengreen, 2019, p. 84).

Elevated during the post-convertible Bretton Woods regime, topic 15—“international”, “monetary”, “system”—captures the broader uncertainty about the future of the Bretton Woods monetary system once the United States, under Nixon, prompted domestic interests ahead of international interests. Topic 15 is also elevated in the transition regime as the world scrambled, not always successfully, to set up alternative monetary arrangements.

4.7 A second test of uncertainty/ regime specificity

Looking at the average (mean) topic prevalences in the various figures in section 4.6 (and section 4.5), there is a sense that the types of uncertainty identified are regime specific. There are not a lot of topics with mean topic prevalences that are uniformly distributed across regimes. In this section, we offer a more formal test of this proposition.

Specifically, we re-estimate the structural topic model (still with 80 topics) with no covariates. This estimates what is known as a correlated topic model (Roberts et al., 2019): a topic model that allows topics to be correlated but no covariate information is used in forming the topics. We omit the covariates as they condition the topics identified by the model. Therefore, if we use the structural topic model estimated in the previous section, it will bias our results to finding different topics of uncertainty are more prevalent in some regimes than others.

The results from a correlated topic model mean each document (read: newspaper article), d , is described by a vector Doc_d . The vector contains the different proportions of the 80 different topics contained in that document, where the topics are those

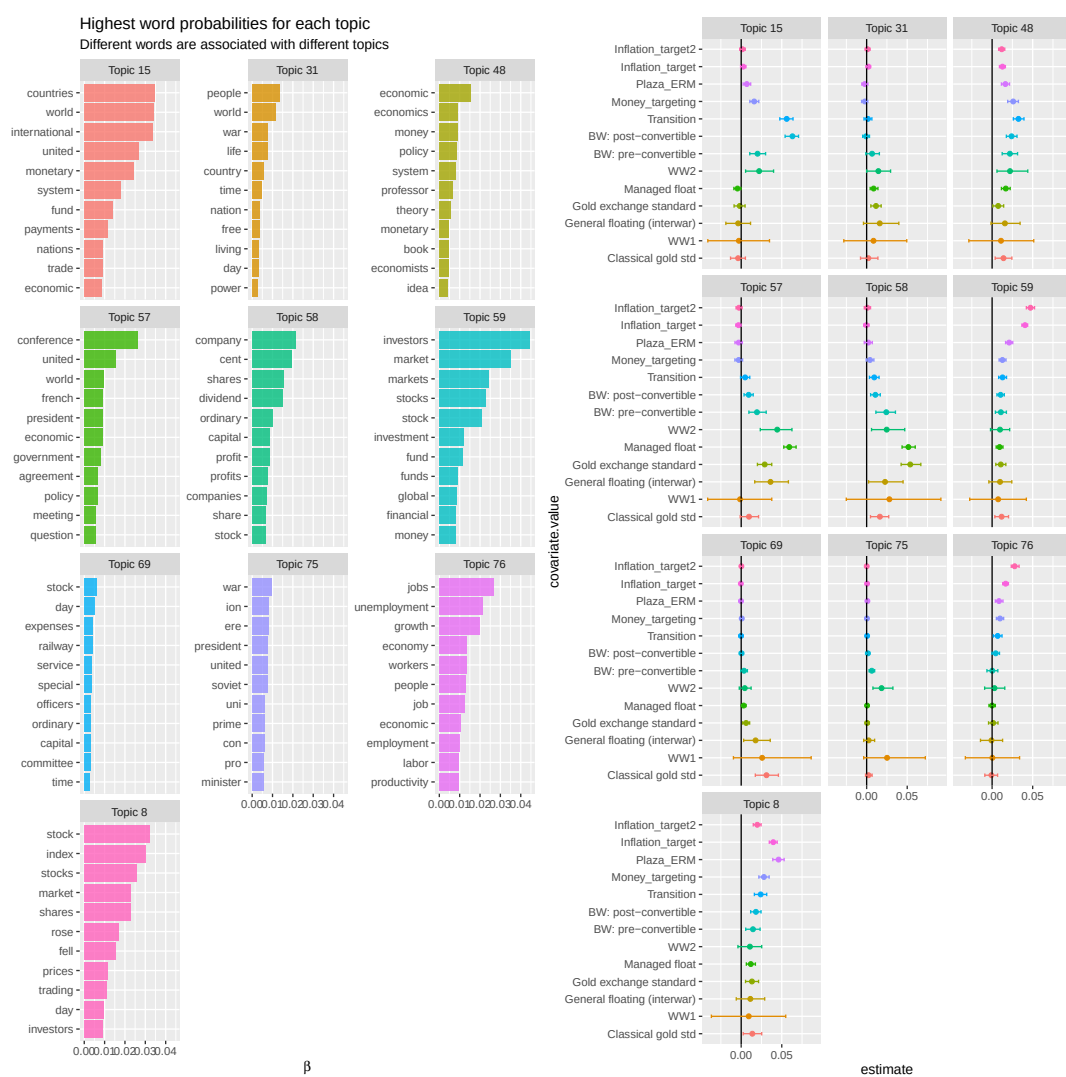


FIGURE 4.19: Other topics

Note β refers to word prevalence in a given topic; 'estimate' refers to the estimate of topic prevalence in each regime

identified by the aforementioned correlated topic model.

$$Doc_d = (\theta_{d,1}, \theta_{d,2}, \dots, \theta_{d,80}) \quad (4.3)$$

One document might have a relatively high value of $\theta_{d,1}$, meaning it is more likely to be about topic 1; whereas another document might have a relatively high value of $\theta_{d,2}$ meaning it is more likely to be about topic 2.

Across all documents, D , for topic i .

$$\sum_{d=1}^{d=D} \theta_{d,i} = 1 \quad (4.4)$$

To see if documents from different regimes have different topic intensities (that is, some topics are more prevalent in one regime than in other regimes), we conduct the following exercise. For all documents, d , occurring in a given year, we average the Doc_d vectors. That is, we calculate the average annual value of $\theta_{d,1}$ for each topic for documents in that year. The advantage of averaging topic prevalence over the year is it removes some of the noise associated with idiosyncratic articles, so we get a representative view of what were generally the topics of uncertainty in that year.

We then calculate the first two principal components across these yearly topic vectors. If there are differences between regimes in terms of the topics of uncertainty, we would expect, when plotted, that years from the same regime would occupy the same space in terms of the two principal components and years from different regimes would occupy different spaces.

Figure 4.20 presents this plot. The years in the post-managed float regimes appear to occupy their own space in figure 4.20—this suggests that the topics of uncertainty experienced in those years are specific to the monetary regime. Of the post-managed float regimes, the only regime where there is some overlap is between the two inflation targeting regimes (see the top left corner of figure 4.20); this is to be expected, given the institutional similarities between the two regimes.

In terms of the pre-World War 2 regimes, years in the classical gold standard appear to occupy their own space, but there is a strong overlap between the general floating regime and the gold-exchange standard regime. Two years in the managed float regime overlap with the general floating and the gold-exchange standard regimes. The three regimes share many similarities: they all had heightened uncertainty about the exchange rate. Two of them were floating exchange rate regimes, while in the gold exchange standard regime, one, the sterling's exchange rate was deemed overvalued and, two, financial flows were not flowing in stabilising directions—both sources of exchange rate uncertainty. Secondly, trade, which had been of benefit to, and benefited from, the classical gold standard, was more restricted under these regimes. Thirdly, countries, for various reasons, had become more nationalistic: as discussed, domestic policy objectives, such as unemployment, gained weight against international concerns, as the right to vote was extended. Further, countries focused on directing domestic policy to pay down war debts. This focus on domestic priorities, at the expense of international policy cooperation, was a common informal institutional setup over those regimes. Further, international policy cooperation was not helped, in the words of Bernanke and James (1991, p. 36) by: 'the inexperience and insularity of the new potential hegemon (the United States), and ineffective cooperation among central banks left no one able to take responsibility

for the system as a whole.⁶²

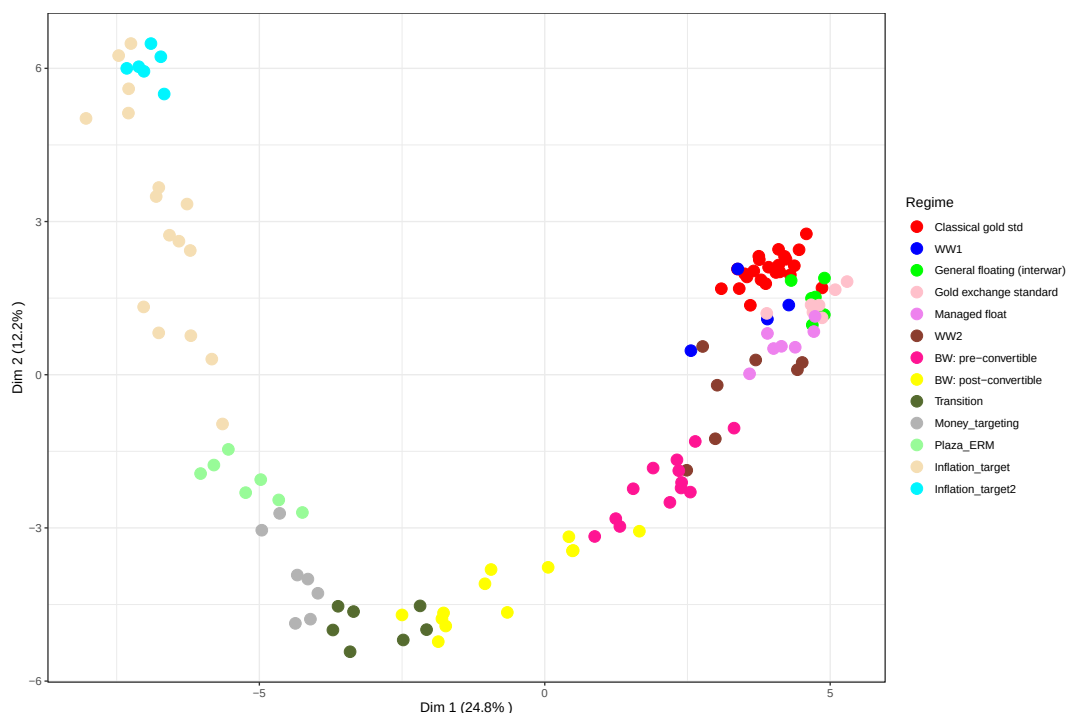


FIGURE 4.20: Annual topic heterogeneity by regime as measured by the first two principal components: 80 topic model

One potential criticism of our approach is by creating a relatively large number of topics, we bias the results towards finding regime-idiosyncratic exogenous uncertainty. An example may help to explain this argument. As we noted above, three topics (8,58, 59) relate to stock market uncertainty and are more prevalent at different points in history. It may be that our topic model is creating event-specific topics in some cases and, arguably, these are all the same topic: stock market uncertainty. Our ten-topic model created only one stock market uncertainty topic. To see if our large number of topics is driving our results, we re-estimate our model with ten topics and redo our principal components, and these results are presented in figure 4.21. The results are broadly similar, but it becomes clearer that the gold standard can be considered idiosyncratic in terms of the types of uncertainty experienced.

Another potential objection to our general finding that uncertainty is regime specific is that this is being driven by the idiosyncratic shocks that regimes have had to deal with. In section 4.4.1, we noted Bordo (1995) argues supply shocks can be thought of as exogenous shocks the regime had to deal with, while demand shocks might reflect the performance of the regime itself. To isolate topics of uncertainty emanating from the regime itself, we, therefore, re-estimate the topic model with the supply and demand shocks we estimated in section 4.4.1 as covariates in the model; we then isolate topics where demand shocks are statistically significant, but supply shocks are not statistically significant (using a five per cent p-value in both

⁶²One problem with principal components analysis is not all information from the original data is contained in the two principal components reported. In our case, 37 per cent of the variation in the data is explained by the two principal components. An alternative approach to dimension reduction is auto-encoders, which use neural network works to compress all information into two or three dimensions. Using the Kera's package in R, we reduce the data dimension using auto-encoders. The results are reported in the appendix with the key conclusion being the same as our principal components analysis: uncertainty is generally regime-specific, particularly post war.

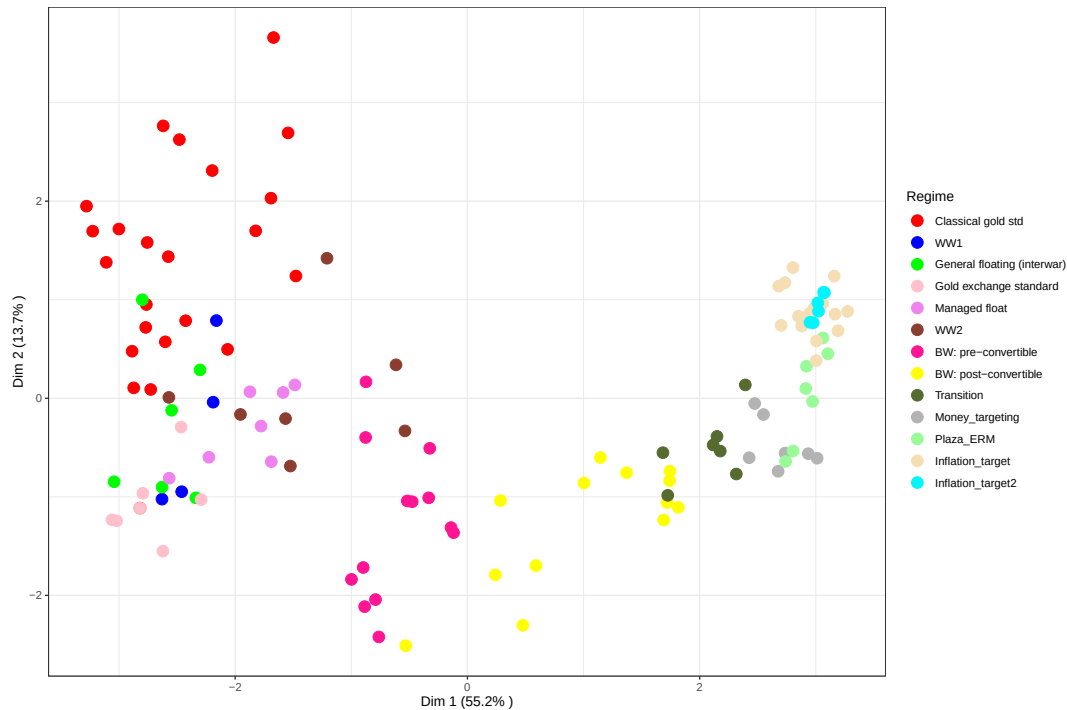


FIGURE 4.21: Annual topic heterogeneity by regime as measured by the first two principal components: 10 topic model

instances).⁶³ We then re-estimate the principal components (see figure 4.22). The gold standard still stands out as idiosyncratic, but now the interwar regimes overlap less. Further, there is also more demarcation in terms of some of the post-war regimes: in particular, there is less of a significant overlap in the transition, money targeting, and Plaza Accord era regimes and in the two inflation targeting regimes.

⁶³These topics are reported in the appendix. Examining them, they appear, for the most part, as topics that could be thought of as emanating from the regimes themselves, rather than reflecting external influences. Possible exceptions are topics 30, 39, 43 and 67, which relate to politics and fiscal policy/management.

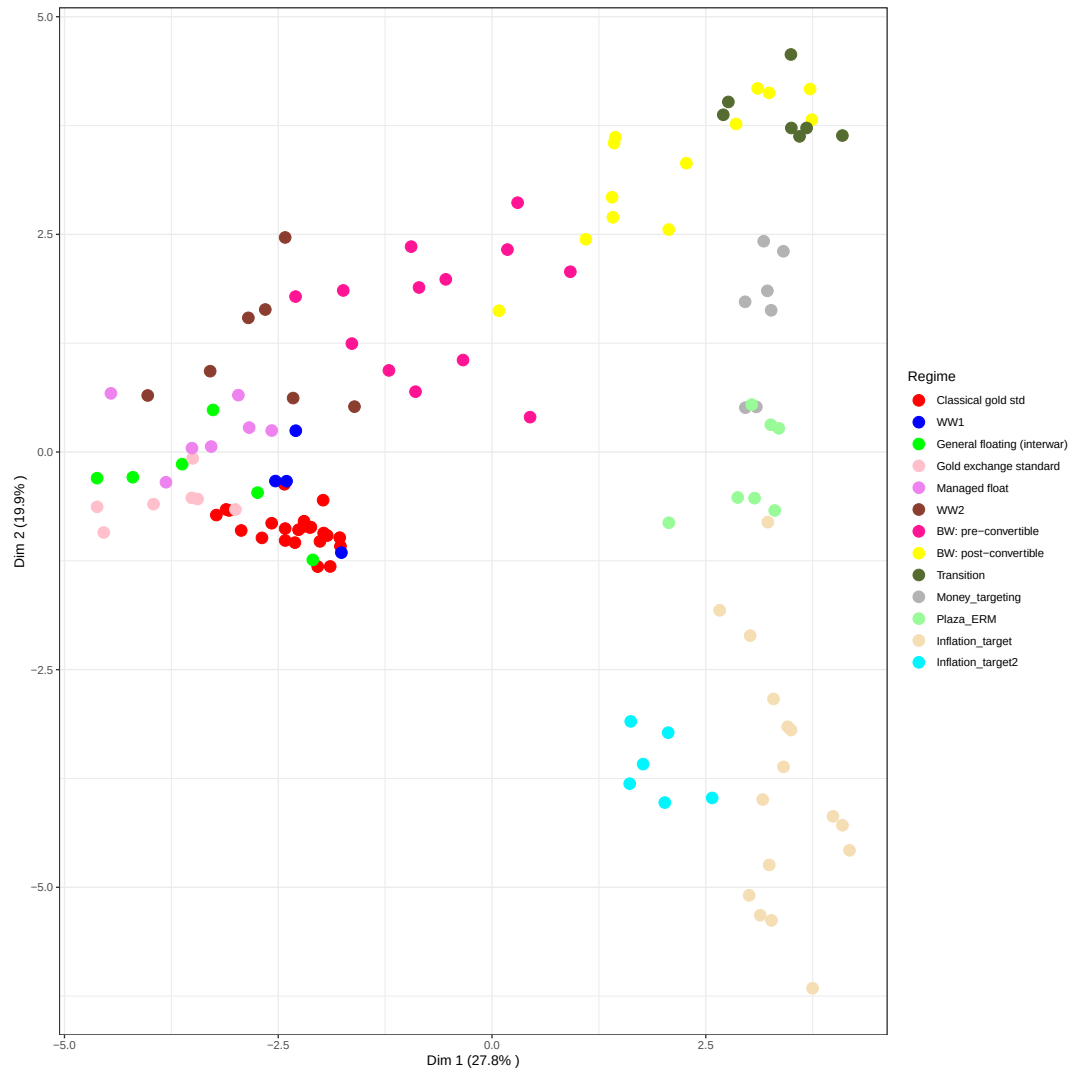


FIGURE 4.22: Annual topic heterogeneity by regime as measured by the first two principal components: 80 topic model but only topics correlated with demand shocks

4.8 Conclusion

This paper researched two questions using modern text-mining tools on a large corpus of documents. The first research question asked which monetary regime had the lowest and highest level of uncertainty. Excluding the World Wars, we find the Bretton Woods (pre-convertible phase) and the interwar general floating exchange rate regimes had the lowest level of uncertainty. The finding that the early part of the Bretton Woods regime had relatively low uncertainty is consistent with other literature but the finding that the interwar general floating regime did deviates from existing studies. Further research could delve into why the results from our text-based research differ from volatility-based research. The regime with the highest uncertainty is the managed float regime, which is not a surprise, given it included much of the Great Depression and its aftermath.

Our second research question asked if types of uncertainty were idiosyncratic to regimes. We sought to answer this question via three different methods: a dictionary-based approach where we studied the frequency of different economic terms and

their analogies; an unsupervised learning approach that uncovered latent topics and tested the significance of individual regimes in determining topic prevalence; and an approach that compared the similarity of topic vectors. All approaches suggest evidence that the composition of uncertainty was regime idiosyncratic, particularly post World War 2.

The paper is a broad sweep of institutional regimes and events that are associated with uncertainty within these regimes. Using the large corpus we have created, there is an opportunity for further, more detailed econometric work to look at how specific monetary regime changes altered the composition of uncertainty. Further work needs to be done to distinguish the effects of the regime itself on uncertainty versus external influences. This could involve expanding the model of Bayoumi and Eichengreen (1994) to better identify shocks emanating from the monetary regime or using the methods of causal inference (as surveyed by Cunningham, 2021, for example) to contrast the composition of uncertainty in countries that changed regimes with those that did not.

4.9 Appendix

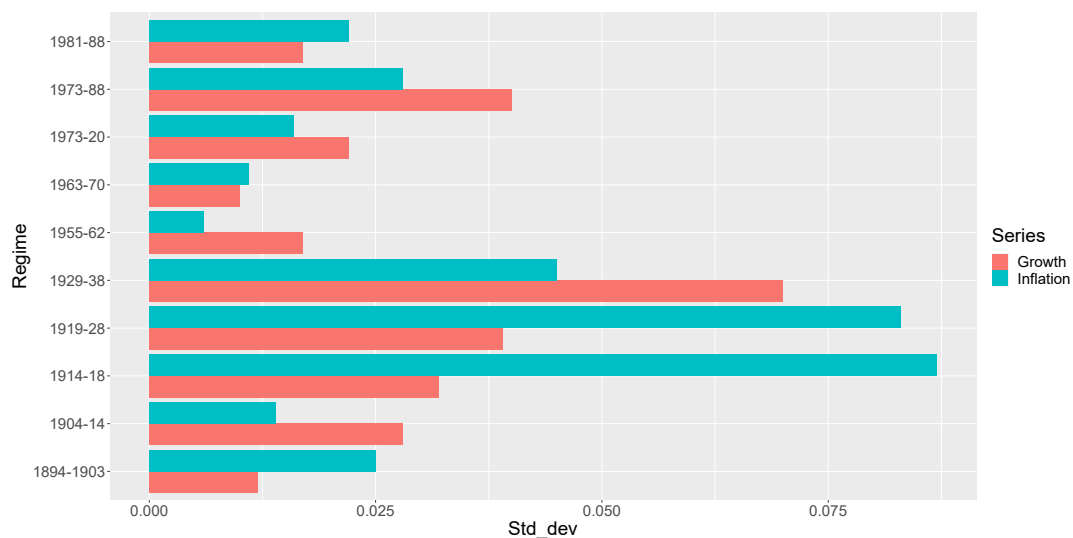


FIGURE 4.23: Uncertainty by period from Bayoumi and Eichengreen (1994)

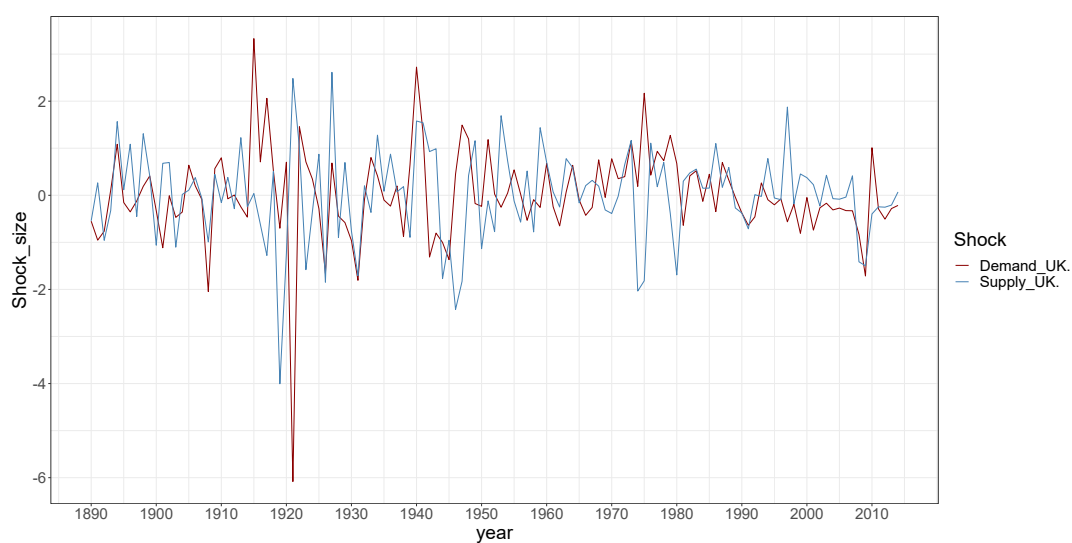


FIGURE 4.24: Estimated historical shocks from our estimation of the Bayoumi and Eichengreen (1994) model on UK data

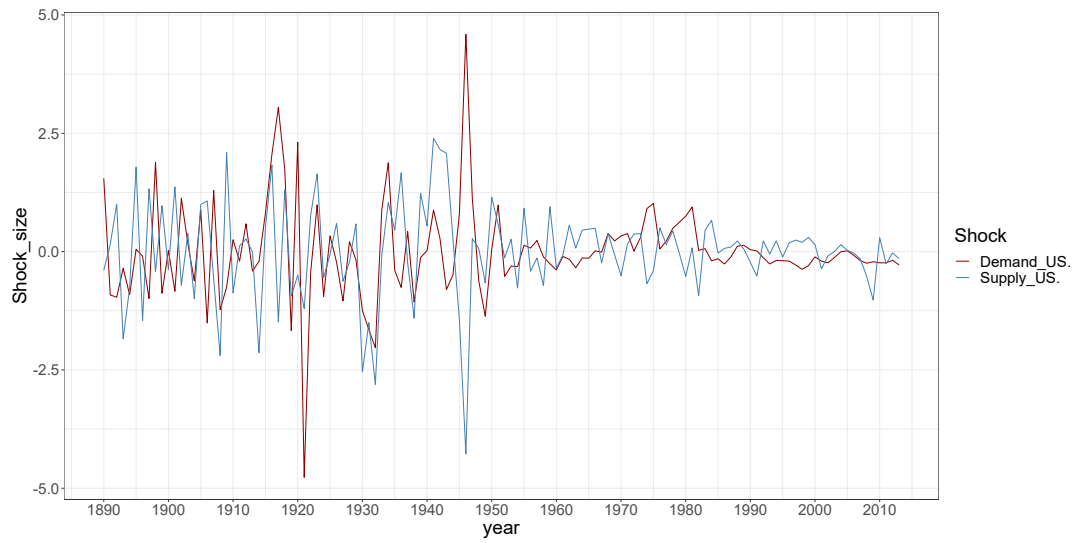


FIGURE 4.25: Estimated historical shocks from our estimation of the Bayoumi and Eichengreen (1994) model on US data

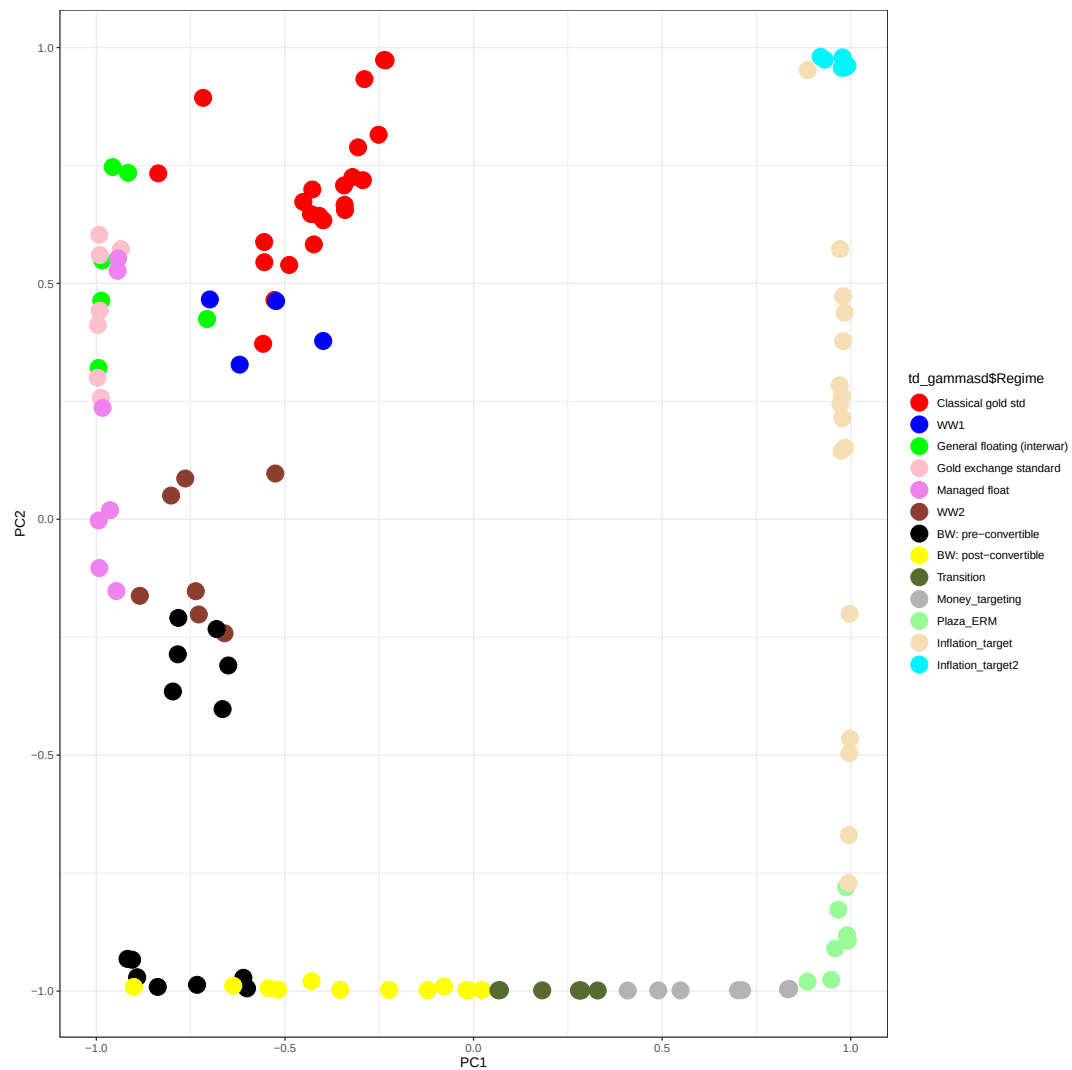


FIGURE 4.26: Annual topic heterogeneity by regime as measured by the autoencode

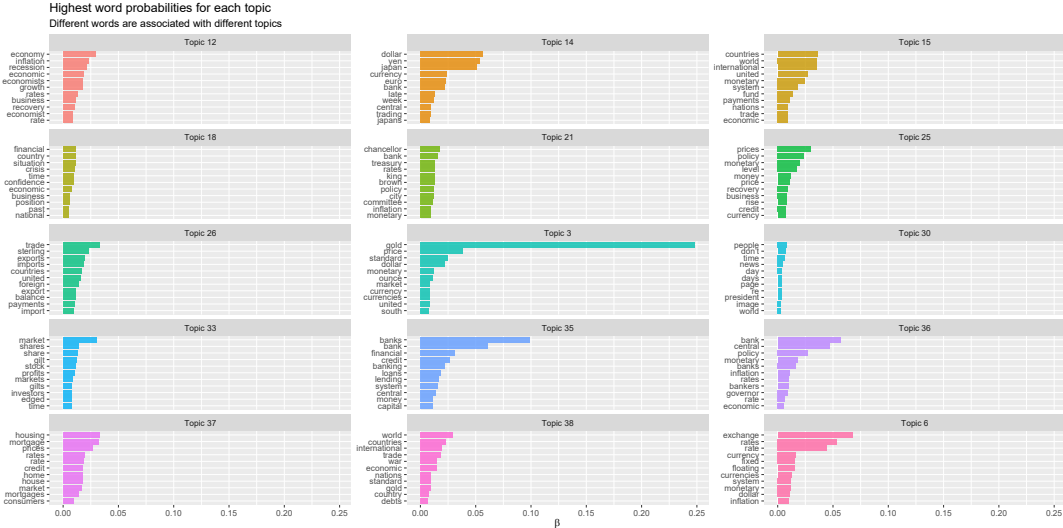


FIGURE 4.27: Topics significantly-related to demand shocks: part 1



FIGURE 4.28: Topics significantly-related to demand shocks: part 2

Chapter 5

Constructing narrative instruments with unstructured text: An application to policy uncertainty

Abstract

Policy uncertainty is all pervasive, but good, econometrically-robust estimates of its effects are difficult to achieve due, in part, to the simultaneity between uncertainty and the business cycle. In this paper, we quantify the effects of policy uncertainty on the economy using a proxy structural vector autoregression. Our instrument is a set of policy uncertainty events exogenous to the business cycle narratively identified via latent Dirichlet analysis of a very large corpus of parliamentary records. Most of the exogenous uncertainty events we identify relate to the well-known economic reforms the New Zealand economy experienced in the 1980s and 1990s.

JEL codes: C32, C36, C63, D80, E32, L50

Keywords: Latent Dirichlet allocation; narrative identification; uncertainty; instrumental variables; policy; proxy SVAR

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5.1 Introduction

Uncertainty is a fundamental concept in macroeconomics, as its unexpected movements (or shocks) are generally seen as important for helping explain, among other things, the dynamic behavior of asset prices, investment, and consumption. In this

paper, our focus is on the effects of policy uncertainty because, for example, while a lockdown to slow the spread of a disease will reduce economic activity, so will unclear guidance about when such a lockdown will be enacted or retracted. Consequently, firm and household decisions may be delayed until the policy becomes clearer. Our, and others (e.g., Baker et al., 2016), interest in the topic, reflects the significance of policy, as a source of uncertainty for many firms and households.

However, measuring the dynamic effects of uncertainty (policy-sourced or otherwise) is challenging because of the difficulty in isolating uncertainty's unexpected movements from its endogenous movements arising from the state of the economy. Of the methods proposed in the literature for isolating uncertainty's unexpected movements (i.e., uncertainty shocks), the simplest (and most common) method, the recursive approach, isolates uncertainty shocks by assuming, somewhat unrealistically, that the relationship between uncertainty and macroeconomic variables is not simultaneous. An alternative method restricts the direction (sign) of the impact of uncertainty shocks on the economy (for example, see Houari, 2022); as Ludvigson et al. (2021) note, this seems inappropriate given that the impact of uncertainty on the economy is ambiguous in theory.¹ Other authors, such as Angelini et al. (2019) and Carriero et al. (2018a) use heteroskedasticity-based schemes to identify uncertainty shocks (Carriero et al., 2018b for an example; while Olea et al., 2021 notes concerns about the general approach), while Ludvigson et al. (2021) employ shock restriction-based methods applied to different historical episodes.

Instrumental variable (IV) estimation, a well-known solution for dealing with simultaneity in econometrics, has been used by various studies to examine uncertainty. For example, Baker and Bloom (2013) examine how uncertainty affects GDP growth by instrumenting their measure of uncertainty (stock market volatility) on a set of disaster events relating to natural disasters, political shocks, revolutions, and terrorist attacks. Carriero et al. (2018a) and Piffer and Podstawski (2018) examine the impact of uncertainty in a wider range of variables than just GDP growth using a proxy structural vector autoregression (SVAR) approach.² Carriero et al. (2018a) use Bloom (2009)'s uncertainty shock series as the instrument in their proxy SVAR; Bloom isolates uncertainty events by looking at the months in which the CBOE S&P Volatility Index (VXO) peaks and then, creates his shock series, by assigning a month a value of one if it contains a VXO peak and zero otherwise.³ As Piffer and Podstawski (2018) note, Bloom implicitly assumes that a high value of uncertainty is due to exogenous causes, and this is not necessarily true. Instead, Piffer and Podstawski (2018) use the variations in the price of gold around the identified uncertainty events as their instrument of uncertainty's exogenous movements.

The approach taken here is similar to those of Carriero et al. (2018a) and Piffer and Podstawski (2018) in two ways: we use a proxy SVAR setup to consider the effects of uncertainty on a wide range of variables, and when creating our instrument, we identify our "uncertainty events" based on uncertainty peaks. However, we depart from these studies by using evidence from narratives to identify the quarters in

¹See Bloom (2014) for a summary of the channels through which uncertainty can have a positive and negative effect on the economic variables.

²Also using the proxy SVAR are Kim (2019) who uses the military spending variable of Ramey and Zubairy (2018) as an instrument to study government spending policy uncertainty and Husted et al. (2020) who construct instrumental variables based on high-frequency data from the bond futures market to instrument their text-based monetary policy uncertainty index.

³Bloom (2009) defines a peak as when the (detrended) VXO is 1.65 standard deviations over the mean of the series.

which the movement in (policy) uncertainty is exogenous to the business cycle.⁴

Narratives are a powerful approach not only for influencing people's behaviours (Shiller, 2019), but also as a lens through which people perceive the world. We argue that periods in which uncertainty is discussed intensely in relation to macroeconomic and financial conditions are those in which movements in uncertainty should be considered to be endogenous to the business cycle. Conversely, periods in which uncertainty is discussed intensely solely in relation to policy and regulation are those of exogenous movements in uncertainty. Indeed, there is a tradition of using narratives in other areas of macroeconomics to isolate unexpected/exogenous movements in variables. Romer and Romer (2010) use budget documents and speeches to isolate exogenous changes in tax motivated by ideology or reducing inherited deficits, from endogenous changes in tax reflecting the state of the economy. The same authors undertake a similar exercise for monetary policy using Federal Reserve documents (Romer & Romer, 2004). Hamilton (2003) and Kilian (2008) identify historical events with exogenous causes to isolate exogenous oil price movements. Antolin-Diaz and Rubio-Ramírez (2018) also use narratives to apply sign restrictions around key historical events in an SVAR.

The narrative approach in these works tends to rely on relatively short and focused texts because of the difficulties inherent in a manual search/identification approach based on reading each relevant piece of text. In the work presented here, our text source, New Zealand's parliamentary record from 1975 to 2017, makes a manual approach infeasible.⁵ As a consequence, we use text-mining techniques suited to unstructured and voluminous text. In this regard, we share a similar spirit to Ter Ellen et al. (2020) who use an alternative text-mining technique, Latent Semantic Indexing, combined with factor analysis to identify monetary policy surprises.

It is important to distinguish our study from studies of uncertainty that have used texts to construct measures of overall and topic-specific uncertainty (Baker et al., 2016; Larsen, 2021; Saltzman & Yung, 2018; Azqueta-Gavaldón, 2017; Xie, 2020; Husted et al., 2020). Their focus is on measuring uncertainty and their text-based indices reflect both endogenous movements in uncertainty and uncertainty shocks. Consequently, Baker et al. (2016, p. 1596) recognize that their results on the dynamic effects of uncertainty cannot necessarily be interpreted as causal. Our focus is on using text to isolate exogenous movements in uncertainty from an uncertainty index constructed using other methods.

Our study's main methodological contribution is to show how a narratively-based instrument can be created when the text is unstructured and voluminous. We see this as important as it extends the scope for the application of the narrative method, which has been shown to have utility in many applications (as evidenced by the publications on monetary and fiscal policy, and oil, cited earlier). One particular application where there appears particular utility for the narrative method is identification in SVARs via external instruments/proxy variables. Stock and Watson (2018, pg. 918) note the "research programme [using external instruments] holds out more potential for credible identification than is typically provided by SVARs using internal restrictions" but finding "instruments is not easy". Through opening up the possibility of creating narrative-based instruments from unstructured and voluminous text, we hope our method will make finding an instrument slightly easier and thus facilitate more credible identification.

⁴Our analysis is conducted on a quarterly basis, whereas Carriero et al. (2018a) and Piffer and Podstawski (2018) conduct theirs on a monthly basis.

⁵New Zealand's parliamentary record is formally known as the New Zealand Parliamentary Debates. Volumes 396 to 726 were kindly supplied to us in machine-readable form by Mubashir Qasim.

Our main contribution in terms of results is to confirm the findings of Carriero et al. (2015) and Kim (2019), but in the specific domain of general policy uncertainty: the recursively-identified SVAR will underestimate the effects of uncertainty on the economy owing to attenuation bias.

The remainder of this paper is organized as follows. In Section 5.2, we show how we construct our instrument. Specifically, we isolate a number of quarters in which uncertainty is heightened; we term these uncertainty events. We then use text-mining techniques to narratively classify which of the events are considered to be exogenous to the business cycle. Section 5.3 outlines the proxy SVAR setup that allows us to use our instrument to identify a set of structural uncertainty shocks. In Section 5.4, we assess the quality of our uniquely identified exogenous uncertainty events as instruments. Specifically, we assess whether our series of narratively identified exogenous uncertainty events meet the relevance and exogeneity conditions required of an instrument using both statistic tests and a qualitative assessment against a commonly understood economic history of our country of interest, New Zealand. In Section 5.5, we discuss our estimates from the proxy SVAR of the dynamic effects of the policy uncertainty shocks on the economy and compare the results with alternative methods of identifying uncertainty shocks. Section 5.6 concludes.

5.2 Constructing a set of narratively identified policy uncertainty events

5.2.1 The source of our narrative

New Zealand is the ideal country to illustrate how policy uncertainty shocks can be identified for two reasons. First, policy uncertainty can plausibly be attributed to non-business cycle-related reasons in two recent periods. During the first period, namely, the 1980s and early 1990s, New Zealand undertook a number of economic policy reforms that were ideologically driven and, in many respects, untested internationally.⁶ During the second period, around 1996, a new election voting regime was introduced: the Mixed Member Proportion (MMP) system. Under MMP, there is a coalition of governing parties. Given that each party initially has different policy positions, this system results in more policy uncertainty (than the previous winner takes all system: first-past-the-post) until an agreement is reached.⁷ If our narrative method identifies exogenous policy uncertainty events correctly, we would expect a high prevalence of such events in these two periods.

Second, New Zealand is an ideal country for our study of policy uncertainty because a high-quality text is available for our narrative identification: the parliamentary record (called Hansard).⁸ Hansard is a useful text source for multiple reasons: the parliamentary debate is predominately about policy, and given that the debate reflects the contemporary issues of the day, it represents a good source of text data to discern when the source of the policy generating the uncertainty can be considered to be exogenous (e.g., policy reflecting ideology) and when the source of the policy

⁶Much has been written about this reform period. For example, Evans et al. (1996) and Dalziel (2002) provide contrasting assessments.

⁷In a similar vein, Redl (2020) proposes that close elections can increase macroeconomic uncertainty.

⁸This is particularly important in New Zealand, as newspapers, the usual source of text information in uncertainty studies, are not available electronically historically for any length of time. Ballingall et al. (2020) create a trade policy uncertainty index for New Zealand and find that the number of articles is too sparse to go back before 1995.

generating the uncertainty can be considered to have occurred because of the business cycle. Furthermore, the parliamentary record in New Zealand is continuously available electronically from 1909.

5.2.2 Identifying events associated with heightened uncertainty

To construct our series of exogenous uncertainty events, we need to identify the quarters associated with heightened uncertainty (following Piffer & Podstawski, 2018, we call these “uncertainty events”). To identify uncertainty events, we first need an uncertainty index. In our application, the index is taken from Ryan (2020a) (also chapter 2 of this thesis). This index is a combination of four (predominately firm-related) uncertainty indicators. The first three indicators are constructed based on firms’ responses to questions about the expected direction of firm-level activity variables (as well as broader economic variables). These indicators are

1. An indicator based on the distribution of firms’ responses (constructed as per Girardi & Reuter, 2016).
2. An indicator that measures the average expectation errors of firms. It is constructed by comparing an individual firm’s expected direction at time $t - 1$ for a given activity, with the actual outcomes at t ; this is then aggregated across activities and firms. We call this measure “*average error*” and it is constructed as per Arslan et al. (2015).
3. An indicator that measures how far, on average, individual firms depart from the *average error* calculated in (2); this is called the “*idiosyncratic error*” and is constructed as per Arslan et al. (2015).
4. The stochastic volatility measure of output uncertainty of Berger et al. (2016)

We use principal component analysis to combine the indicators above into an overall index.⁹

The first three indicators are constructed from a quarterly survey of New Zealand firms conducted by the New Zealand Institute of Economic Research, called the Quarterly Survey of Business Opinion. This survey of firms, which has run continuously since 1961, has two noteworthy features: (i) its respondents are from most industries, except agriculture, utilities, and government and (ii) it uses stratified sampling based on firm employee numbers. However, it excludes all firms with fewer than six employees and includes all firms with more than 200.

Given that the Quarterly Survey of Business Opinion is a survey of firms and that three of our uncertainty indicators are based on this survey, our uncertainty index should be classified as an index of firm uncertainty. The overall index in Figure 5.1 shows that uncertainty is heightened during recession periods (the shaded sections) as well as throughout the 1984 to 1995 economic reform period discussed earlier.

In Figure 5.1, the dot-dash lines show the election dates. We also see that uncertainty spikes around elections, particularly after the introduction of the MMP voting system in 1996. The shaded areas are recessions from Hall and McDermott (2016).

⁹For our five sectors, the first three indicators are created for each of the j questions individually. To create a sector version of each indicator, we take a principal component across the j questions. The three sector indicators are then aggregated into a combined sector index by taking the arithmetic average. An economy-wide index is next created by weighting the combined sector indices by their GDP weights. A principal component of this index and indicator four is the final index. See Ryan (2020a) for more details.

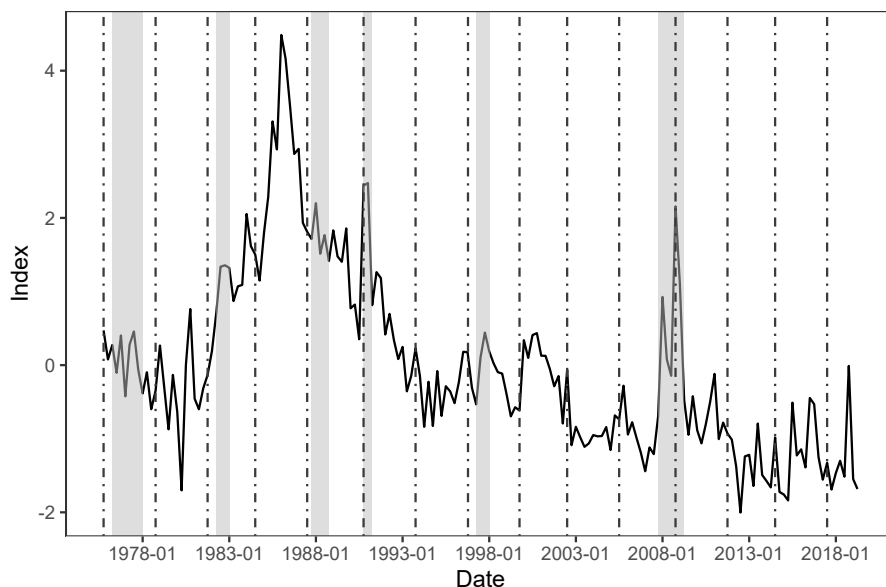


FIGURE 5.1: New Zealand uncertainty index

To construct our list of uncertainty events, we convert the continuous uncertainty index variable into a dummy variable that takes a value of one if the index is above its mean value.¹⁰ Otherwise, a value of zero is assigned.

Accounting for the correlation between news and uncertainty

Typically, bad news about the state of the economy is correlated with heightened uncertainty. Piffer and Podstawski (2018, pg. 3267) note: “One challenge faced in identifying uncertainty shocks consists of separating uncertainty shocks from news shocks”; they show that news and uncertainty shocks have different effects on financial as well as on real and nominal variables, with news shocks affecting financial variables more. To ensure that we do not confound the two shocks, we thus modify our measure of uncertainty to better isolate our shocks of interest: uncertainty shocks.

Unlike Piffer and Podstawski (2018), who use an estimated series of news shocks from previous research, we need to create our own, as we are not aware of any such studies in New Zealand.¹¹ To do this, we take three forward-looking questions from the Quarterly Survey of Business Opinion. The questions relate to firms’ investment intentions over the next 12 months for plant and machinery as well as for buildings and firms’ outlook for the general business situation in New Zealand over the next six months. Each of these questions has a time series associated with them, which is the net balance of firms’ responses (the percentage of firms expecting an increase minus the percentage expecting a decrease, normalized by a factor that takes into account non-applicable responses). We take the first principal component of these three series and then the first difference, which is our news variable. We hypothesize

¹⁰This is a more relaxed criterion than that employed by Bloom (2009). He identifies uncertainty events as when the uncertainty series is 1.65 standard deviations above its sample mean in a quarter. As noted in the Introduction, Bloom (2009) equates high uncertainty values with being exogenous. As we determine exogeneity in another way, we are more permissive in the quarters we identify as containing uncertainty events.

¹¹Kamber et al. (2017) do create a news series for New Zealand, but their work only covers 1989Q3 to 2011Q3.

that a large sudden drop in investment intentions and the outlook for the economy reflects a negative news shock.

From our list of quarters identified as containing uncertainty events, we omit any quarter in which our news variable fell by more than 1.65 standard deviations from its mean values; we term these “bad news” events. We identify the following five quarters as being “bad news” events:

1. 1985Q4: The introduction of a new consumption tax (Goods and Services tax) was announced in the previous quarter.
2. 1987Q4: The 1987 stock market crash.
3. 2000Q2: The bursting of the dot-com bubble.
4. 2005Q4: The close re-election victory of a Labour government (business has traditionally viewed Labour less favourably).
5. 2008Q4: The start of the second, more intense, phase of the global financial crisis.

Our measure of news is similar to the expectations measure of Leduc and Sill (2013). They note their measure can reflect news about future fundamentals unrelated to current fundamentals but also animal spirits; so there is a risk, therefore, we are not omitting events associated with bad news, but rather falls in animal spirits. However looking at the above list, *from the view point of New Zealand firms*, the events appear to reflect news about future fundamentals. Large contractions in financial markets (items 2,3 and 5 on the list) mean that, one, export demand is likely to be lower, and, two potentially the availability of finance is less (or more costly) for some time to come; a consumption tax (item 1) will lower demand in the economy, while a (perceived) less business-friendly government (item 4) potentially means business is more costly to conduct.

5.2.3 Identifying uncertainty events with exogenous causes

Using the above approach, approximately half the quarters in the sample are identified as containing uncertainty events. We now need to distinguish between events in which (i) high uncertainty appears to be in response to the state of the economy and (ii) high uncertainty appears to be in response to policy; our focus is on the latter. To do this, we use the parliamentary record.

The parliamentary record is lengthy (approximately 1.6 million words per year on average in our sample from 1975 to 2017) and unstructured in terms of the topics discussed. The typical parliamentary sitting day includes 12 questions necessitating oral answers as well as the reading of bills on a broad range of subjects.¹² As manually reading the parliamentary record is extremely time consuming owing to its length, we need a method that allows us to structure the text to carry out our narrative classification.

To isolate the topics of regulation discussed in the text on the corporate earnings calls of US companies, Calomiris et al. (2020) take a 41-word window around the term regulation. To identify about which the topics of uncertainty, we do the same but apply the 41-word window around any of the words “uncertain,” “uncertainty,”

¹²For example, on May 27, 2020, the day we first drafted this sentence, the subjects of the oral questions included, but were not limited to the economy, social development, and transport; the subjects of the bills included the budget, smoke-free environments, and the gas market.

and “uncertainties.”¹³ Figure 5.2 shows the annual counts of these windows, where the upward trend reflects that Hansard word count is increasing each year.



FIGURE 5.2: Counts of uncertainty windows per year

The 6,972 identified windows are treated as separate “documents”: each document, in our case, is a mention of uncertainty (and the 40 words surrounding it). We now want to classify each mention of uncertainty based on its theme. Following Calomiris et al. (2020), we use a natural language processing technique called latent Dirichlet allocation (LDA).¹⁴ The LDA algorithm (developed by Blei et al., 2003) is based on two ideas. The first is that documents consist of a mixture of different topics, but the proportion of each topic differs by document. The second idea is that each topic is a mixture of words in different proportions (more concretely, for each topic there is a probability distribution across words that varies by topic). For example, a topic about the economy has a high probability of containing the words “GDP” or “inflation,” while a topic about regulation is likely to contain “law,” “compliance,” and so on.

LDA is an iterative algorithm that works by taking a given word in a given document¹⁵ and constructing a conditional probability distribution across topics for the word in that document, with topic k having a higher probability of being associated with that word in a given document if (i) other words in the document are associated with that topic and (ii) the word is associated with topic k in other documents.

¹³The 41-word window is isolated in the corpus of text that has had a set of common pre-processing steps applied to it (i.e., the removal of “stop” words, punctuation, digits, and one-letter words. In light of the conclusion of Schofield and Mimno (2016) that “stemmers produce no meaningful improvement in likelihood and coherence and in fact can degrade topic stability” (p. 287), we do not stem. Further, we keep people’s names in the dataset, as these are typically the responsible minister and therefore are useful for defining topics.

¹⁴Larsen (2021) isolates different topics of uncertainty using LDA on Norwegian newspaper articles and creates topic-specific uncertainty indices, finding that different types of uncertainty have different effects on the economy. However, his study focuses on the measurement of different types of uncertainty rather than using it to identify shocks. See also Gentzkow et al. (2019) for an overview of LDA’s application (as well as other techniques for text analysis) in economics.

¹⁵We use both individual words and bigrams as our units.

The algorithm then samples from this conditional probability distribution to assign the word in the document to a new topic. The algorithm iterates over words and documents. There is no training sample, and the algorithm begins by randomly assigning words to topics. To compute the conditional probability distribution, the LDA algorithm uses Bayesian methods, particularly Gibbs sampling (see the appendix). We implement LDA using R's TextMineR (Jones, 2019).

One key parameter in the LDA algorithm is the number of topics you ask it to create: if you specify too few, the topics are too general; if you specify too many, the topics become too specific (i.e., the topics will not generalize across documents or mentions of uncertainty). We run the algorithm four times, searching for 50, 60, 70, and 80 topics on each run. We then compare the coherence score for each run and find that 70 topics maximize this value.¹⁶

With 70 topics identified, we then label each topic based on the top 20 words associated with the topic. Labelling has two components. A less important "specific label" that identifies the specific nature of the topic and a "general" label from the following:

- "Endogenous/economy": the specific topic relates to the state of the business cycle (seven topics).
- "Firm-related policy": the specific topic relates to a policy area likely to affect firms (e.g., regulation, energy, and taxation) (20 topics).
- "Other policy": the specific topic relates to a policy area unlikely to directly affect firms (e.g., education, health, and social welfare) (32 topics).
- "Other/unknown": it is either hard to allocate the topic a label owing to the incoherence of the words associated with it or the topic appears to relate to procedural matters in parliament (11 topics).

Figure 5.3 shows nine topic examples. The first column shows three examples of "endogenous/economy" topics, the second column three firm-related topics, and the third column three "other policy" topics. Focusing on the first row, the first topic has a combination of words related to the economy ("economy," "growth," "financial," and "crisis") and is therefore allocated the specific label "economy" and, more importantly, is given the general label "endogenous/economy." The second topic relates to the cost of regulation; given that this affects firms, we allocate this the general topic label of "firm-related policy." The final topic relates to education (e.g., "schools," "children") and is allocated the specific label "education" and the general label "other policy." We focus on firm-related policy topics, as our uncertainty index is constructed using (predominately) firm survey information (see Section 5.2). Table 5.7 in the appendix provides more information on firm-related policy topics.

LDA provides each document—in our case, mention of uncertainty—a probabilistic distribution across the range of possible topics; for a given document/mention of uncertainty, all these probabilities sum to one. Figure 5.4 shows the probability distribution of the first mention of uncertainty in our dataset (although all topics with a probability of less than 0.01 are excluded for readability). We see that topic 20 has the highest probability of being associated with this uncertainty mention.

¹⁶Intuitively, at a topic level, a topic receives a higher coherence score if the top words associated with it are also usually found together in the documents/mentions of uncertainty. The overall coherence score is the average of the coherence scores across K topics. The specific coherence score we use is probabilistic coherence, as implemented in R's TextmineR package; more information is available at <https://github.com/TommyJones/textmineR/issues/35>.

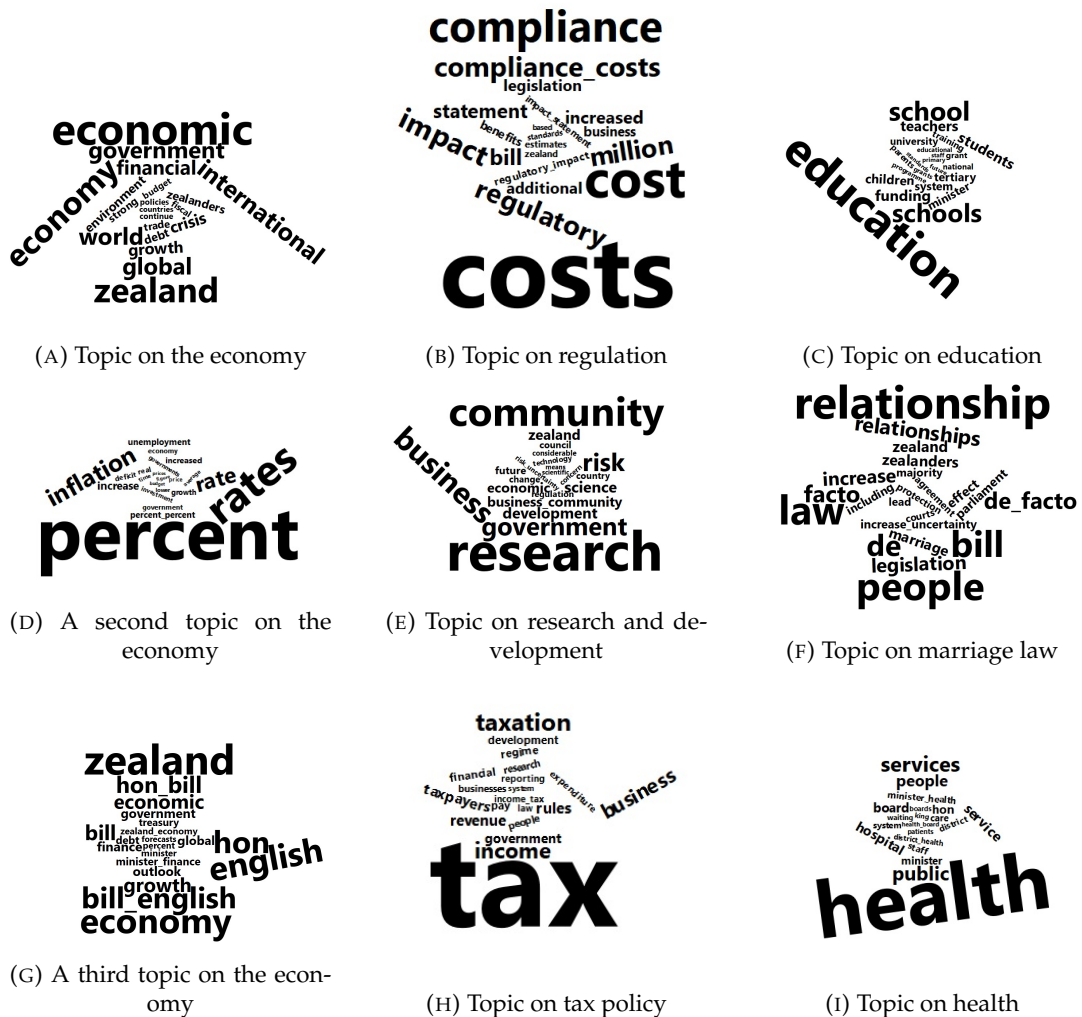


FIGURE 5.3: Word clouds for nine topics

Note: The bigger the word size, the higher probability it is associated with the topic

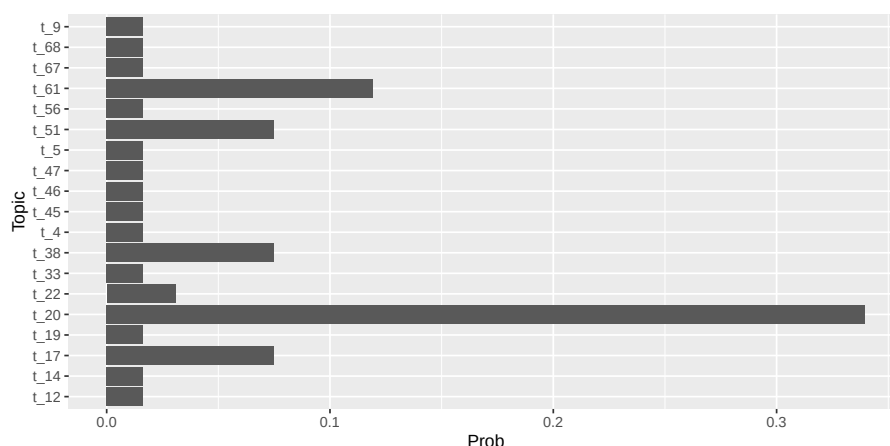


FIGURE 5.4: Topic probability distribution for first mention of uncertainty in the dataset

To assign a topic to each document/uncertainty mention, we first find the topic for that document/uncertainty mention with the highest probability. However, in line with Calomiris et al. (2020), we only allocate a topic to a document/uncertainty mention if the topic with the maximum probability has a probability over 0.5. Only in this case can we be confident that the topic with the maximum probability is representative of the theme of the uncertainty mention; otherwise, the mention is likely to be a relatively even mixture of a number of topics. To check the robustness of this step—the assignment of the topic to an uncertainty mention—we asked three undergraduate commerce students to check if they agreed with the assessment after manually reading the text in a sample of 100 uncertainty mentions. The average agreement rate was 94.1 per cent.¹⁷

In our dataset, we originally identify 6,972 mentions of uncertainty; however, after applying the probability threshold, we have 2,736 (40 per cent of the original dataset). This is our potential first source of measurement error, as some of these omitted mentions of uncertainty may have helped us better identify the reason for the uncertainty event.

We also omit some uncertainty mentions because not all the uncertainty mentions can be reliably allocated to a quarter despite our best efforts, as some of the Hansard volumes span two quarters. This represents a second source of measurement error. The omissions associated with the volume-to-quarter matching issue leave us with 1,881 uncertainty mentions (just over 11 on average per quarter in our sample).

Finally, to identify quarters in which the uncertainty event can be considered as an exogenous event, we calculate the ratio of uncertainty mentions assigned to be endogenous/economy-related to uncertainty mentions assigned to be about firm-related policy in each quarter in which an uncertainty event has been identified. We assign a value of one (i.e., identify the quarter as containing an exogenous uncertainty event) to quarters in which the above ratio is zero (i.e., there are no mentions of economy-related uncertainty and at least one mention of firm policy-related uncertainty).

¹⁷The agreement rate is the number of mentions/ documents they agreed with the assessment of divided by the number of mentions they could ‘confidently’ assess based on their knowledge. The subsample they audited was taken from uncertainty mentions where the topic with the maximum probability was greater than 0.50; this reflects the discussion below.

5.3 Proxy SVAR approach

With a set of uncertainty events identified that is exogenous to the state of the economy, it is tempting to estimate the effects of policy uncertainty on the economy by regressing the uncertainty events (interacted with our uncertainty index) on GDP and other macroeconomic variables. For example, Romer and Romer (2010) regress their set of exogenous tax shocks on GDP to estimate the dynamic effects of tax changes. However, such an approach has been criticized by Mertens and Ravn (2013), who note that “a concern with the existing literature is that the narratively identified exogenous changes ... are implicitly viewed as mapping one-to-one on to the true structural shocks. In practice, there are good reasons to expect that narratively identified shocks suffer from measurement errors as historical records rarely are sufficiently unequivocal that calls of judgment can be avoided” (p. 1213).

Although we do not manually read the text and make judgment calls, as discussed in Section 5.2, our approach to identifying exogenous uncertainty events/shocks will result in measurement error. Mertens and Ravn (2013) and Mertens and Ravn (2014) propose using proxy SVAR to deal with this measurement error. Under this approach, rather than adding our series of narratively identified uncertainty events into the SVAR directly, we use the events series as an instrument.¹⁸

Ultimately, our proxy SVAR aims to recover the latent structural uncertainty shock $\epsilon_{t,u}$ from the SVAR model:¹⁹

$$B(0) \begin{bmatrix} U_t \\ Y_t \end{bmatrix} = B(L) \begin{bmatrix} U_t \\ Y_t \end{bmatrix} + \begin{bmatrix} \epsilon_{t,U} \\ \epsilon_{t,Y} \end{bmatrix} \quad (5.1)$$

where $B(L)$ is the lag operator for the $1, \dots, p$ lags in the model ($p=4$ in our case), Y_t is a vector of the k macroeconomic and financial market variables, and $\epsilon_{t,Y}$ is the associated structural shocks. U_t is an observed measure of uncertainty. This is the uncertainty index of Ryan (2020a), as discussed in Section 5.2.2. $B(0)$ is the contemporaneous impact matrix. Our goal is to identify the column of this matrix that relates to the contemporaneous impact of uncertainty on our macroeconomic and financial market variables of interest.

The vector of the k macroeconomic and financial market variables, Y_t , consists of five variables: the quarterly change in the New Zealand share price index, the output gap, detrended inflation, detrended nominal 10-year interest rate, and detrended real exchange rate. The output gap is created by applying the method of Kamber et al. (2018) to the real GDP series of Hall and McDermott (2011); inflation and the interest and exchange rates are detrended using the Hodrick—Prescott filter (lambda: 1,600). We detrend inflation and the interest and exchange rates, as the 1980s and early 1990s were a period of large structural change in the New Zealand economy (e.g., the introduction of inflation targeting, floating of the exchange rate, and opening up of the economy to foreign capital flows). This means that the equilibrium/natural interest and exchange rates are likely to move.²⁰ Detrending variables has become a contentious issue. The traditional method had been

¹⁸Stock and Watson (2012) were also early in applying an external instrument approach to identify their SVAR.

¹⁹The explanation of the proxy SVAR below closely follows that in the online appendix of Mertens and Ravn (2014).

²⁰The share price index is sourced from OECD (2020), Share prices (indicator). doi: 10.1787/6ad82f42-en [Accessed on 15 June 2020], the inflation data are sourced from Statistics New Zealand's Infoshare, the real exchange rate data are sourced from the Bank for International Settlements (narrow version of the real exchange rate):

the Hodrick-Prescott filter but this has recently been criticised by Hamilton (2018) for, amongst other things, introducing 'spurious dynamic relations that have no basis in the underlying data-generating process' (Hamilton, 2018). Unfortunately, Hall and Thomson (2021) establish, in the New Zealand context, that Hamilton's proposed alternative has 'no material advantage ... over the HP filter for the purpose of presenting stylised business cycle facts' (Hall and Thomson (2022)). One is therefore left searching for other alternatives. Hall et al. (2017), however, conclude "that, on balance, stylised business cycle facts from standard HP1600 filtering could be preferred over those from BK [Baxter-King filter], CF [Christiano and Fitzgerald filter], and two loess (local regression) trend filtering methods". The alternative method of Kamber et al. (2018) for constructing output gaps is not evaluated in any of the papers by Hall and Thompson (and co-authors) but appears to identify output gaps that are consistent with a commonly understood narrative of recent New Zealand economic history. Specifically, the output gap is negative around the recession in the early nineties, the Asian Financial crisis and the Global Financial Crisis. With the Global Financial Crisis being associated with the largest negative output gap. Further, Kamber et al. (2018, p.565) concludes when applying their method to the G7, Australia, and New Zealand that their filter: "is able to produce intuitive estimates of output and unemployment gaps in the sense of concordance of movements in the gaps over the business cycle, not just for the United States, but for other countries as well." We, therefore, use the Kamber et al. (2018) method to construct our output gap. In terms of why we use the Hodrick-Prescott filter for the other (non-output gap) variables, we were informed by Hall et al. (2017) result that the standard HP1600 filter is preferable over other filters, and Hall and Thomson (2021) which established that the Hamilton filter has no advantage over the HP filter in the New Zealand context.

Hall, Thomson and McKelvie (2017) Hall et al. (2017) Hall and Thompson (2021) hHall and Thomson (2021)

Hall and Thompson (2022) Hall and Thomson (2022) Phillips and Shi (2021) Phillips and Shi (2021)

To recover $\epsilon_{t,u}$, we must first estimate the reduced-form VAR:

$$A(L) \begin{bmatrix} U_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \eta_{t,U} \\ \eta_{t,Y} \end{bmatrix} \quad (5.2)$$

where $A(L)$ is the lag operator for the $1, \dots, p$ lags in the model, $\eta_{t,Y}$ is a vector of innovations associated with the macroeconomic and financial variables, and $\eta_{t,u}$ is the innovation associated with the uncertainty variable.

Mertens and Ravn (2014) show the relationship between the structural shocks and reduced-form innovations can be written as

$$\eta_{t,u} = \hat{\tau} \eta_{t,Y} + \hat{\phi} \epsilon_{t,U} \quad (5.3)$$

$$\eta_{t,Y} = \hat{\omega} \eta_{t,U} + \hat{\rho} \epsilon_{t,Y} \quad (5.4)$$

where $\hat{\tau}$ is a $1 \times k$ vector, $\hat{\phi}$ is a scalar, $\hat{\omega}$ is a $1 \times k$ vector, and $\hat{\rho}$ is a $k \times k$ vector.

We require an instrument, m_t , that meets two conditions:

1. $E[m_t, \epsilon_{t,U}] \neq 0$ (the relevance condition)
2. $E[m_t, \epsilon_{t,Y}] = 0$ (the exogeneity condition)

That is, an instrument is contemporaneously correlated with structural uncertainty shocks (i.e., an instrument that meets the relevance condition) but contemporaneously uncorrelated with the other structural shocks in the model (i.e., an instrument that also meets the exogeneity condition). In Sections 5.4.2 and 5.4.3, we test whether our proposed instrument, the narratively identified uncertainty event series, meets these conditions.

The structural uncertainty shocks can be uncovered as follows:

1. In equation 5.4, m_t can be used to instrument for the reduced-form VAR uncertainty innovation ($\eta_{t,U}$). The instrument “isolates” movements in the uncertainty innovation unrelated to Y_t , thereby providing an unbiased estimate of $\hat{\omega}$.
2. The residual from equation 5.4 can then be used as an instrument in equation 5.3 for the reduced-form VAR macroeconomic variables’ innovations, $\eta_{t,Y}$, providing an unbiased estimate of $\hat{\tau}$. Intuitively, the residual from equation 5.4 can be thought of as the movements of $\eta_{t,Y}$ not related to uncertainty and this thus allows for an unbiased estimation of $\hat{\tau}$.
3. The variance of the residual from equation 5.3 provides an estimate of $\hat{\phi}$.

In their online appendix, Mertens and Ravn (2014) show that the estimates of $\hat{\phi}$, $\hat{\omega}$, and $\hat{\tau}$ are sufficient to identify the column of $B(0)$ relating to the impact of uncertainty shocks in our case (tax shocks, in the case of Mertens & Ravn, 2014). This is sufficient to calculate the impulse responses for the response of the macroeconomic and financial variables to structural uncertainty shocks.

We restrict our estimation sample to 1985Q2 to 2017Q4. Although our instrument goes back to 1975Q4, we restrict the starting date of our estimation period for two reasons. First, before 1984, parliament did not sit in the first quarter of the calendar year; this means no text data are available to construct our instrumental variable for these quarters. Second, the New Zealand dollar was floated in 1985Q1 (a significant regime shift for a small economy). Therefore, it is better to start the estimation period after this event.

5.4 The quality of our narratively identified instrument

5.4.1 A qualitative assessment

Using the methodology discussed in Section 5.2.2, and after removing the quarters associated with bad news classified in section 5.2.2, we identify 17 quarters after 1985Q2 in which exogenous uncertainty events occurred (see Table 5.1).²¹

As expected, the period of New Zealand’s ideologically based economic reform from 1984Q2 to 1995Q4 contained a high number of narratively identified uncertainty events. This is consistent with the economic reforms being a response to perceived economic performance over a number of years, meaning much of the policy change over the period reflected ideological motives, particularly the idea that more economic decisions needed to be made by the market.

Table 5.1 shows the cluster of narratively identified uncertainty events in 1986 (1986Q1, 1986Q2, and 1986Q4). There were a number of significant events as part of the reform this year. April saw the introduction of a new Commerce Act to promote

²¹Given we estimate our proxy SVAR from 1985Q2, we focus this discussion on the uncertainty events after this date.

market competition for the benefit of consumers; the prospect of increased competition would have increased uncertainty for those firms that had enjoyed protected (particularly from overseas competition) or monopoly status until then. The 1986 budget contained measures to reduce tax evasion and avoidance, while the fourth quarter of 1986 saw the implementation of a consumption tax (GST). That year also saw the corporatization of a number of providers of key business inputs such as electricity and postal services.

Late 1987 saw the re-election of the Labour government, but internal disagreement about how far the reform should go started to show. This disagreement was particularly between the Prime Minister and Minister of Finance; the latter eventually resigned. Indeed, despite the Minister of Finance's flat tax package already having been agreed by the cabinet, the Prime Minister publicly vetoed it in January 1988. Table 5.1 shows that we narratively identify an uncertainty event in 1988Q1. Tax also appears to drive the event identified in 1989Q1: increased GST and business tax rates were announced in the quarter.

TABLE 5.1: Quarters in which exogenous uncertainty events are narratively identified

Year/quarter	Q1	Q2	Q3	Q4
The economic reform period				
1986	x	x		x
1988	x			
1989	x			
1991			x	x
1992		x		x
First MMP coalition government				
1996			x	
1997			x	x
1998	x			
Post-1999				
2000			x	x
2008	x			
2009	x			

Despite a change in government in 1990, economic reform continued with vigour. Table 5.1 shows two uncertainty shocks in 1991 (1991Q3 and 1991Q4). This year saw radically new labour and resource management laws. The resource management law (enacted in 1991Q3) had significant implications for planning processes (in terms of both restrictions and costs), affecting the construction industry and other industries where their activities impact on the environment. The new employment law (enacted in 1991Q2) meant anyone could bargain on behalf of workers, which represented a marked change from the system of employer–employee relations in place for nearly 100 years.

Two events are identified in 1992 (1992Q2 and 1992Q4); these quarters border the September 1992 referendum on the electoral system. While the result of the referendum was non-binding, the government committed to holding a binding referendum if there was a majority vote for change. Around 85 per cent of voters voted

for change with the majority supporting the MMP system.²² Additionally, immediately before the first election under MMP in October 1996, an uncertainty event is identified (1996Q3).

The potential change in the way those who write the laws are elected appears to have heightened policy uncertainty. Why so? The previous first-past-the-post system under which the candidate with the most votes in an electorate won the seat and the party with the most seats governed meant the sole winning party could pursue its policy goals unimpeded. By contrast, under MMP, seats are allocated in broad proportion to the party vote, meaning parties need to form coalitions to form a ruling majority in parliament. Coalitions mean compromise on policy but also brinkmanship to obtain policy concessions. Before and immediately after an election, the voting public is not always clear which policies will last the coalition negotiations. During the coalition arrangement, policy might be revisited or reversed as minor parties seek to appease their voter base. Further, coalition agreements are imperfect like all contracts; it is therefore not always clear which parties' interests will dominate when the coalition faces new issues.

A number of uncertainty events are identified about halfway through the first term of the first coalition government elected under MMP (1997Q3 to 1998Q1). The first MMP government was formed following an election in which the two major parties received an approximately equal share of the vote, and it was left to a party with 8.5 per cent of the vote (New Zealand First) to decide who would govern. It was an unstable arrangement with the Prime Minister replaced a year into the parliament (December 1997), as it was felt that he had given New Zealand First too much influence. The coalition ended halfway through the three-year term of the parliament when the new Prime Minister sacked the leader of New Zealand First from the cabinet (August 1998). The uncertainty events we identify in this period (1997Q3–1998Q1) appear to reflect the lead-up and aftermath of the change in Prime Minister. This is unsurprising, as such a change typically alters the direction and focus of policy.

In late 1999, the newly elected centre-left Labour-led coalition replaced the perceived more business-friendly National-led coalition. We identify two uncertainty events in the final two quarters of 2000, reflecting changes to labor laws. August 2000 saw the introduction of new employment legalization to, according to Rasmussen et al. (2019, p. 66), “contain unfair use of employer power” and overcome the “union hostile elements” of the previous employment legislation. December 2000 saw the announcement of significant increases in the minimum wage, with a nearly 70 per cent increase for those aged 18 and 19 (see Hyslop & Stillman, 2007).

Finally, we narratively identify uncertainty events in 2008Q1 and 2009Q1. The fourth quarter of 2008 saw a change in government as the centre-right National government took power. The uncertainty event immediately after the election may reflect nervousness about new coalition arrangements, particularly as two of the coalition partners—the ACT and Maori parties—were new to government. Alternatively, it could reflect uncertainty about the government's response to the global financial crisis, or the announcement of a tax working group, which was considering options to reform the tax system.

The narratively-identified uncertainty shock in 2008Q1 warrants discussion. It may reflect uncertainty about the policy response to the initial financial shock caused

²²Source: <https://www.parliament.nz/en/get-involved/features/25-years-since-mmp-referendum/> [accessed 20 July 2020].

by the downturn in the US subprime mortgage market in the previous year. Importantly, our empirical setup does not require the instrument, which is the narratively identified uncertainty event series, to be orthogonal to the history of the other variables in the model (Mertens & Ravn, 2013; p. 1217) or as Stock and Watson (2018, pg. 919) put it the instrument does not have to be uncorrelated with past and future shocks. That is, it allows for uncertainty events to reflect uncertainty about government policy in response to a macroeconomic or financial structural shock, as long as the policy response is delayed and given the typical legislative process, most are.

Another possibility is that the identification of 2008Q1 as an exogenous uncertainty event reflects measurement error. After all, Bear Sterns was bailed out on March 17, 2008 and the Federal Reserve cut interest rates by 75 basis points a day later. The Hansard volumes that relate to this quarter ran from February 12, 2008 to March 13, 2008 (volume 646) and from March 18, 2008 to April 17, 2008 (volume 647). As noted earlier, when a volume spans two quarters as volume 647 does, it is difficult to attribute an uncertainty mention to a quarter and this is a source of measurement error. Given the concurrence of the dates spanned by the problematic volume 647, and the timing (mid-March) of the Bear Sterns event and interest rate cut, 2008Q1 might be incorrectly classified as an exogenous uncertainty event. However, this illustrates the utility of the approach, as Mertens and Ravn (2013) (p. 1217) note that the instrument does not need to correlate perfectly with the structural uncertainty shocks; some measurement error is allowed.^{23,24}

5.4.2 Instrument exogeneity: a statistical assessment

The exogeneity assumption, namely, that our narratively identified measure of uncertainty events/shocks (i.e., our instrument) is contemporaneously uncorrelated with the other structural shocks in the model, is not directly testable, as the true structural shocks are unobserved. Constructing our instrument by including only the quarters in which economy-related uncertainty is not discussed in parliament, we hope to meet the exogeneity assumption by construction.

We do conduct some partial tests for instrument exogeneity however. Firstly, we regress our instrument on the structural shocks from an estimated recursive SVAR (see equation 5.5):

$$\epsilon_{R,t,i} = \beta_1 + \beta_2 * m_t + \zeta_t \quad (5.5)$$

where m_t is our instrument and $\epsilon_{R,t,i}$ is the structural shock i from the recursive SVAR.

The recursive SVAR is ordered: the uncertainty index, stock prices, output gap, inflation, interest rate, and real exchange rate; identification is achieved via Cholesky decomposition and the model is estimated with four lags. Table 5.2 shows that there are no statistically significant relationships between the non-uncertainty structural shocks and our instrument when significance is assessed at either the 5 or the 10 per cent level.

As the studies by Bloom (2009) and Carriero et al. (2015) (the latter use the uncertainty series of Bloom, 2009 as an instrument) have been well cited, we compare and contrast our results with those we would have obtained if we had followed the

²³Omitting 2008Q1 as an event from our data set makes little difference to our results reported in section 5.5.

²⁴It is possible that one or more of the quarters: 1997Q3, 1997Q4 and 1998Q1, are also misclassified as exogenous as the Asian Financial Crisis hit at that time.

Bloom (2009) methodology (i.e., if we had equated peaks in the uncertainty index with exogenous uncertainty shocks rather than relying on the narrative to identify exogeneity). Following Bloom (2009), we take our uncertainty index (see Section 5.2.2), detrend it using the Hodrick–Prescott filter ($\lambda = 1,600$), and then identify quarters as having uncertainty shocks when the detrended series is 1.65 standard deviations above its mean.²⁵ The ‘Bloom method’ part of Table 5.2 shows that the instrument based on this method also satisfies the exogeneity condition.

TABLE 5.2: Statistics assessing the exogeneity of the instrument using recursive SVAR shocks

<i>Dependent variable:</i>					
Recursive SVAR structural shock					
	Stock price	Output	Inflation	Interest rate	RER
Instrument					
β_2 Estimate	−3.33	−0.14	0.09	0.02	−0.10
p-value	0.17	0.12	0.65	0.20	0.89
Bloom method					
β_2 Estimate	−0.01	0.13	−0.32	0.32	−0.36
p-value	0.98	0.75	0.39	0.42	0.52

*Note: RER denotes the real exchange rate
P-values are based on heteroskedasticity-robust standard errors.*

This test, however, is not a conclusive test of instrument exogeneity because we regress our instrument against the structural shocks identified using the recursive restrictions we criticized in the Introduction.

Piffer and Podstawski (2018) test the exogeneity of their instruments by regressing them against identified oil, monetary, and fiscal policy shocks as well as financial and news shocks from other studies. Such shock series are difficult to source for New Zealand for the whole period of our study, so we make use of the shock series we can source. We have some estimates of fiscal and monetary policy shocks for part of our sample, 1985Q2 to 2010Q2, from the model we estimate in chapter 3.²⁶ As a reminder, the model in chapter 3 identified government spending and net tax shocks using the Blanchard and Perotti (2002) method and, in one specification, we included interest rates in the model. Table 5.3 shows that there are no statistically significant relationships between the fiscal, GDP and monetary policy shocks from this model, and our instrument, when significance is assessed at either the 5 or the 10 per cent level. In contrast, the instrument based on the ‘Bloom method’ has statistically significant relationships with both tax and monetary policy shocks. Finally, in table 5.4 we test our instrument against the news shocks from the baseline, three variable model of Beaudry and Portier (2014) (for a sample of 1985Q2 to 2015Q3) and the oil supply shocks of Baumeister and Hamilton (2019) (who have shocks for

²⁵Bloom (2009) uses the monthly VXO as his uncertainty index; hence, he applies a different lambda.

²⁶And importantly we identify no exogenous uncertainty quarters outside the sample period 1985Q2 to 2010Q2.

our whole sample).²⁷ Table 5.4 shows our instrument still appears exogenous to both oil supply and news shocks, although we caution that the Beaudry and Portier (2014) news shocks are estimated from U.S. data so are not New Zealand specific (although the New Zealand economy is heavily impacted by overseas events). The instrument based on the ‘Bloom method’ fails the exogeneity test with respect to oil supply shocks.

Taken together, the results reported in 5.2, 5.3 and 5.4 give us a degree of confidence in the exogeneity of our instrument. The same can not be said of the instrument based on the ‘Bloom method’.

TABLE 5.3: Statistics assessing the exogeneity of the instrument using fiscal and monetary shocks from chapter 3

	<i>Dependent variable:</i>			
	Government spending	Structural shock		Monetary policy
		Net Tax	GDP	
Instrument				
β_2 Estimate	-0.47	0.88	0.12	-0.0004
p-value	0.44	0.44	0.62	0.99
Bloom method				
β_2 Estimate	-2.97	0.92	0.62	-0.45
p-value	0.03	0.38	0.33	0.04

Note: P-values are based on heteroskedasticity-robust standard errors.

TABLE 5.4: Statistics assessing the exogeneity of the instrument using news and oil shocks from other papers

	<i>Dependent variable:</i>	
	News	Oil supply
Instrument		
β_2 Estimate	0.23	0.19
p-value	0.33	0.45
Bloom method		
β_2 Estimate	-0.52	0.95
p-value	0.37	0.003

Note: P-values are based on heteroskedasticity-robust standard errors.

²⁷The shocks of Baumeister and Hamilton (2019) are monthly however. We, therefore, use the quarterly mean of their monthly shocks.

5.4.3 Instrument relevance: a statistical assessment

We conduct two tests of instrument relevance. The first begins by calculating the heteroskedasticity-robust F-statistic from the regression of the reduced-form VAR uncertainty residual/innovation on the instrument. R  th (2020) notes that instrument relevance can be assessed by testing the null hypothesis that the instrument is irrelevant using the Wald statistic from the above regression. Both our instrument and the Bloom-based instrument reject the null hypothesis of instrument irrelevance (see the Wald p-values in Table 5.2).

Another way to assess instrument relevance is to use the rule of thumb of Stock and Yogo (2005): the heteroskedasticity-robust F-statistic from the above regression is above 10, which “assures approximately valid coverage of confidence intervals” (R  th, 2020, p. 6). However, Lunsford (2015, p. 3) argues that the “weak IV rule of thumb that requires an F-statistic to be greater than 10 will lead to tests that are mis-sized.” He proposes regressing the instrument on the relevant reduced-form VAR residual and provides critical values that depend on the VAR dimension and bias tolerance. Using a bias tolerance of 10 per cent (as Lunsford, 2015 does), the 95 per cent critical value for the F-statistic is 7.81. The last row of Table 5.5 shows that the F-statistic associated with our instruments exceeds the critical value; however, the Bloom-based instrument fails this test.²⁸ Taken together, this suggests that our instrument does not suffer from the weak instrument problem. The evidence is more mixed, however, for the instrument-based on the Bloom method.

TABLE 5.5: Statistics assessing instrument relevance

Test statistic	Instrument	Bloom method
Wald p-value	0.006	0.000
Lunsford	8.15	7.56

Note: Wald p-value are based on heteroskedasticity consistent standard errors. The Lunsford test uses HAC standard errors owing to the low values of the Durbin–Watson statistic in this equation.

5.5 Results

We first estimate our proxy SVAR using the narrative-based instrument series. Figure 5.5 plots the impulse response for a one-unit shock to our uncertainty index (the solid line). Two (90 per cent) confidence sets are also shown, both calculated following Montiel Olea et al. (2021). The first is the delta-method confidence set based on the plug-in estimator (area bounded by the black dotted lines) with heteroskedasticity-robust standard errors, and the second is the weak instrument robust confidence set (the shaded area).²⁹ Montiel Olea et al. (2021) note that the weak instrument-robust confidence set being wider than the delta-method confidence set based on the plug-in estimator provides evidence of a weak instrument. As Figure 5.5 shows, we do not generally observe this for our instrument, indicating that it is not weak and thereby confirming our assessment in Section 5.4.3.

²⁸Our tests are based on HAC standard errors. The Bloom-based instrument does pass if Huber–White–Hinkley standard errors are used; however, an autocorrelation allowance appears necessary according to the Durbin–Watson statistic.

²⁹Based on 10,000 bootstrap replications. The weak instrument robust confidence set of Montiel Olea et al. (2021) is not subject to the criticism of those based on wild bootstrap procedures leveled by Br  ggemann et al. (2016)

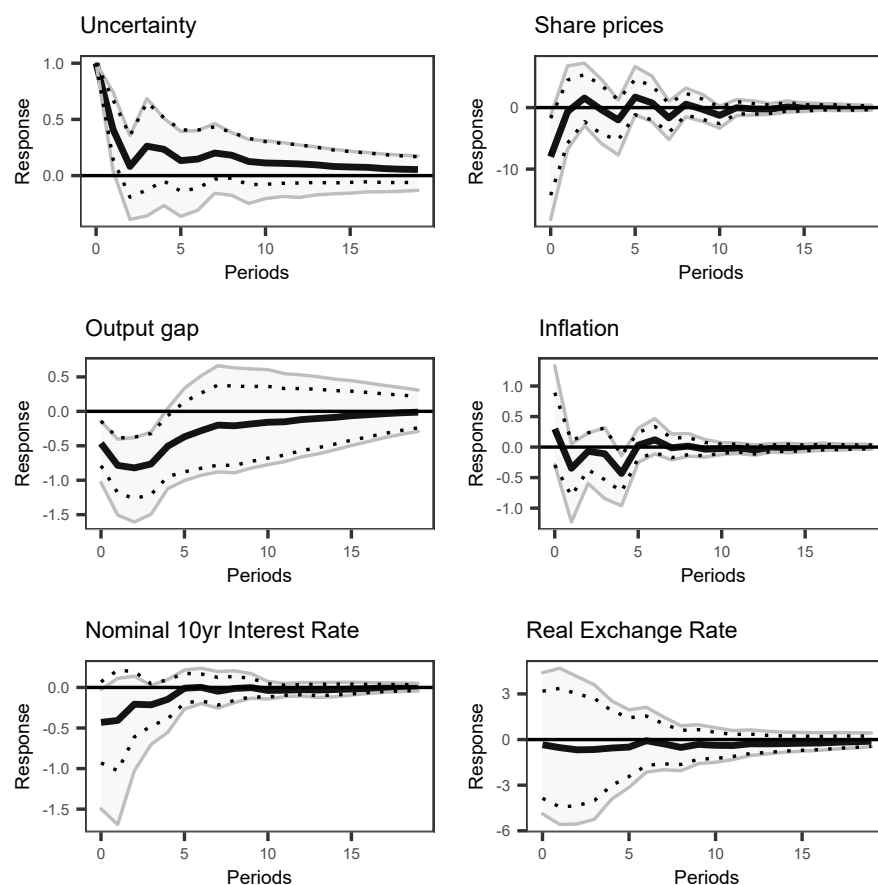


FIGURE 5.5: Responses of the variables to a one-unit shock to uncertainty: Proxy SVAR using the narrative-based instrument

Note: Impulse responses from the proxy SVAR identified via the narrative instrument are the solid lines. Shaded areas are the 90 per cent weak-instrument robust confidence sets. The areas enclosed by the dotted lines are the 90 per cent delta-method confidence sets.

Uncertainty shocks have a large negative impact on output and share prices. The fall in output is consistent with declines in investment and consumption. A weaker economy also leads to weaker (non-tradables) inflation (the impact on inflation from the uncertainty shock is statistically different from zero according to both confidence sets in the fourth quarter after the initial shock), as there is more spare capacity. Although nominal long-term interest rates fall, the impact on interest rates from uncertainty is not statistically different from zero at a 90 per cent level of confidence.

We first compare our results with those from a recursively identified SVAR (see Figure 5.6).³⁰ The solid line in each graph in Figure 5.6 is the impulse response from our proxy SVAR. The dot-dash line is the equivalent impulse response from the recursively identified SVAR. Comparing the recursive and proxy SVAR impulse responses in each graph, the impact of attenuation bias owing to improper identification of uncertainty shocks in the recursive SVAR becomes obvious. With the exception of the real exchange rate, the proxy SVAR shows much more pronounced impacts from uncertainty shocks on macroeconomic and financial market variables. Our general finding that the proxy SVAR reduces attenuation bias is consistent with the findings of Carriero et al. (2015) and Kim (2019). The proxy SVAR estimates that a one-unit uncertainty shock has a peak impact of a 0.8 percentage point reduction in the output gap, whereas the recursive SVAR estimates a peak 0.3 percentage point reduction. This 0.3 percentage point reduction is in line with other estimates in New Zealand using a recursive setup. For example, Greig et al. (2018) find a peak impact of between -0.25 and -0.35 percentage points on the output gap three to four quarters after the initial one-unit shock to domestic uncertainty measures.³¹

A second comparison is made with a proxy SVAR that uses a Bloom (2009)-type instrument, namely, an instrument that equates exogeneity with high uncertainty values; this is the set up used by Carriero et al. (2015). Figure 5.7 shows the impulse responses for the proxy SVAR with the Bloom-based instrument.

The proxy SVAR with the Bloom-based instrument finds a statistically significant negative impact on the real exchange rate. Apart from that, however, uncertainty shocks do not appear to have statistically significant effects on the macroeconomic and financial variables in our model at 90 per cent confidence sets. This suggests, at a minimum, the Bloom-based approach is better at identifying uncertainty shocks when constructed from data that are of a higher frequency or constructed from financial market data—he uses monthly VXO data. Alternatively, narrative-based approaches may be better at isolating exogenous uncertainty shocks.

Forecast error decomposition and historical decomposition

Table 5.6 shows the contribution of uncertainty shocks to the four quarter ahead forecast error in variables in our model. We find that the uncertainty shocks identified using the proxy SVAR and our narrative-based instrument explain a much larger percentage of the forecast error in output, the share price, and interest rates than the shocks identified using the recursive SVAR and the proxy SVAR identified by the Bloom-based instrument.

We now compare our estimates to other papers, with a particular focus on the output gap. Greig et al. (2018) report uncertainty shocks explain between 20-22

³⁰The recursive SVAR setup is discussed in Section 5.4.2.

³¹They find slightly larger impacts from foreign uncertainty shocks. Our results are directly comparable to theirs, as we both normalize the uncertainty series in terms of standard deviations from the mean. Tran et al. (2019), using the data-rich approach of Jurado et al. (2015), find similar impacts on the output gap as Greig et al. (2018).

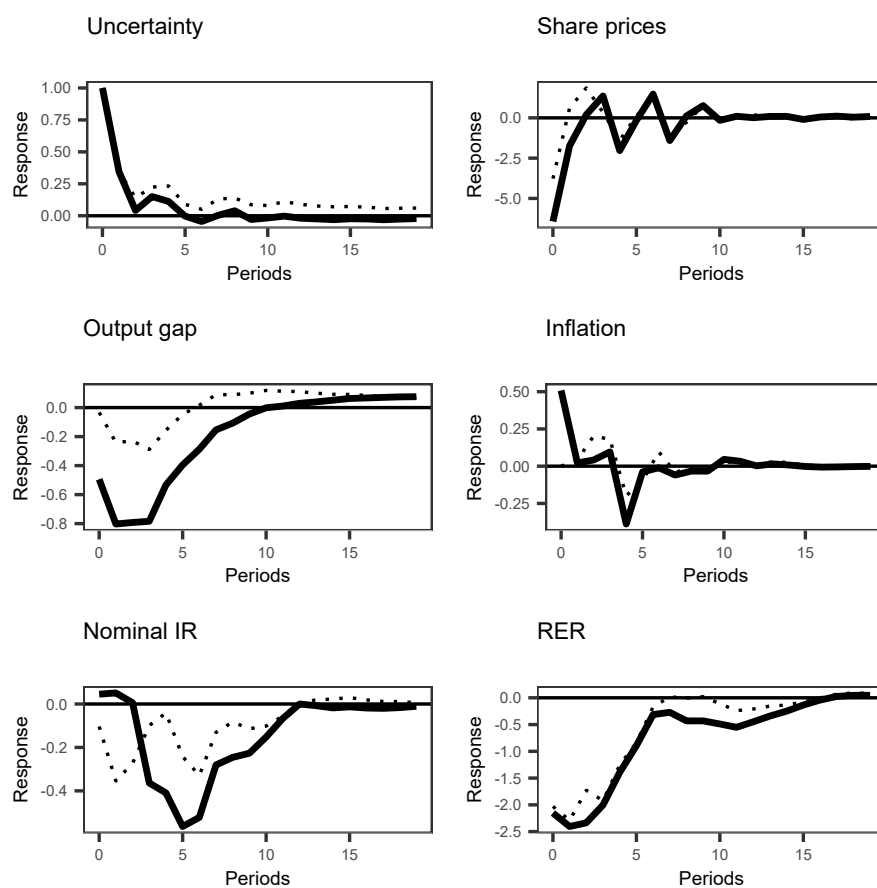


FIGURE 5.6: Responses of the variables to a one-unit shock to uncertainty: Comparison of the proxy and recursive SVARs

Note: Proxy SVAR impulse responses are the solid lines. Recursively-identified SVAR impulse responses are the dotted lines.

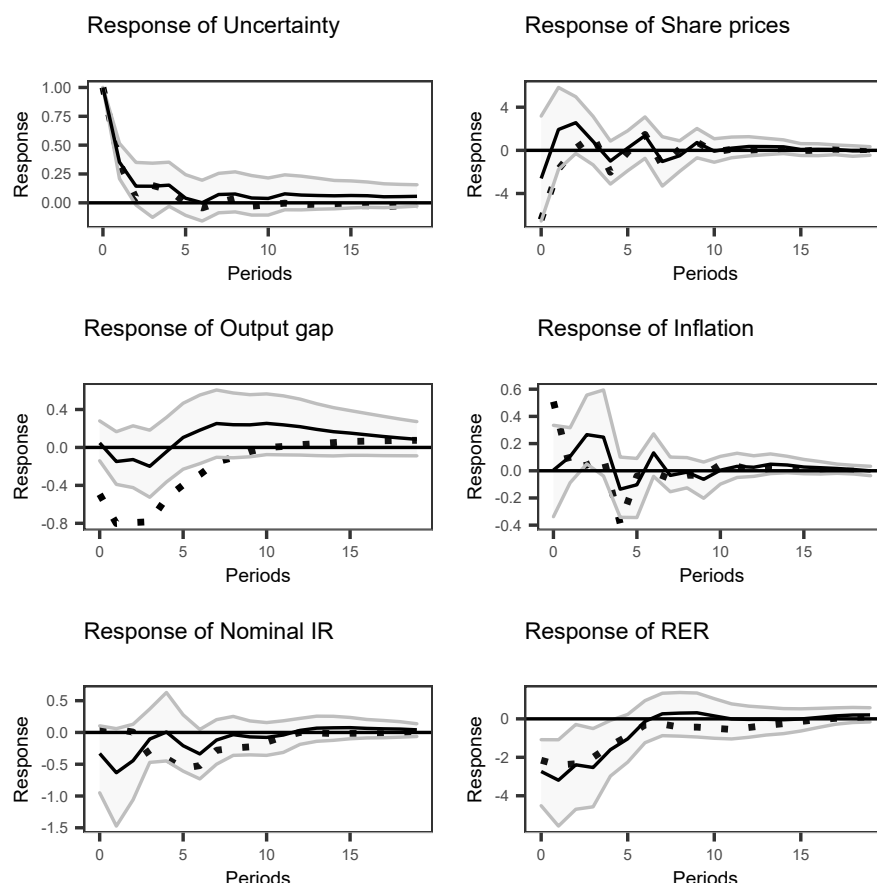


FIGURE 5.7: Responses of the variables to a one-unit shock to uncertainty: proxy SVAR with the Bloom-based instrument

Note: Impulse responses from the proxy SVAR identified via the narrative instrument are the dotted lines. Impulse responses from the proxy SVAR identified via the Bloom-type instrument are the solid lines. Shaded areas are the 90 per cent weak-instrument robust confidence sets from proxy SVAR identified via the Bloom-type instrument

per cent of the four-quarter-ahead forecast error of the output gap (depending on the measure of uncertainty),³² while at the eight-quarter-ahead horizon uncertainty shocks explain between 24–28 per cent of the forecast error in the output gap. Tran et al. (2019) report New Zealand uncertainty explains between 20 and 32 per cent of the forecast error in the output gap at the four-quarters horizon, depending on the sample. Our estimate of the contribution of uncertainty shocks to the four-quarter-ahead forecast error in the output gap is 44 per cent, higher than the estimates reported in these studies but not unreasonably so. Further, our estimate of the contribution of uncertainty shocks to the eight-quarter-ahead forecast error in the output gap is 27 per cent, this is in line with Greig et al. (2018).

³²These estimates are based on their results using uncertainty indices constructed using New Zealand data. We report these results as our uncertainty index is also constructed using New Zealand data.

Variable	Recursive	Proxy: Our Instrument	Proxy: Bloom Instrument
Share price	7.3	15	7
Output gap	8.7	44	3.7
Inflation	2.1	6	7.5
Interest rate	2.1	14	0.3
Real exchange rate	8.3	0.6	16

TABLE 5.6: Forecast error variance decomposition for four quarters ahead

5.6 Conclusion

This study showed using narrative methods on text data to identify exogenous changes in a variable, such as Romer and Romer (2010) demonstrated with tax changes, can be extended to identify exogenous changes in a variable when the narrative source is unstructured and lengthy such as our source, the parliamentary record. Moreover, although any narrative identification procedure can result in measurement error, the proxy SVAR method deals with such error, which means that the two approaches are ideal complements.

Relative to an estimation strategy based on recursively identifying the SVAR or constructing instruments for uncertainty shocks based on equating the peaks in uncertainty with exogenous uncertainty events (as Carriero et al., 2015 do with the uncertainty series of Bloom, 2009), we find that uncertainty shocks have a larger impact on macroeconomic and financial variables (apart from the real exchange rate) when the shocks are narratively-identified. This reflects the reduction in attenuation bias owing to the better identification of uncertainty shocks using our narrative method.

Given we find policy uncertainty can have high costs on the economy. Policy-makers need to announce and implement policy in such a way to minimise such uncertainty. This will be particularly important during the recovery from, the Covid-19 pandemic.

We suggest some opportunities for further work. Firstly, further validation of the exogeneity of our identified uncertainty shocks using the shocks identified in other studies as Piffer and Podstawski (2018) do. Specifically, the application of natural language techniques to problems in economics is still in its infancy. Our procedure to create the instrument is relatively simple and based on a well-known natural language technique, latent Dirichlet allocation. No doubt more sophisticated techniques can be applied to creating instruments.

5.7 Appendix

Keywords associated with firm-related policy topics

5.7.1 Additional information on Latent Dialect allocation (LDA)

The probability that a word, w , in a given document, d , is associated with topic k is given by³³

³³This explanation draws on the video lecture from the course INST 414: Advanced Data Science at UMD's iSchool by Jordan Boyd-Graber. Available at <https://www.youtube.com/watch?v=u715hhmdc0M>.

TABLE 5.7: Keywords associated with firm-related policy topics

Specific topic label	Word 1	Word 2	Word 3
Agriculture	food	forest	farmers
Industry	industry	review	law
Electricity	electricity	companies	price
ACC	accident_compensation	job	job
Regulations	regulations	law	review_committee
Dairy Industry	dairy	milk	industry
Research and Development	research	science	business_community
Fisheries	fisheries	environmental	protection
Legislation	regulations	provision	bill
Energy	power	water	energy
Tax	tax	income	business
Agriculture	dairy_industry	farming	agriculture
Emissions trading	emissions_trading	price	kyoto
Transport	transport	green	charges
Financial	insurance	financial	auditor
Labour	employment	workers	relations
Energy (hydrocarbons)	energy	oil	gas
Business	investment	australia	rules
Communication sector	commerce	communications	contract
Compliance costs	compliance_costs	regulatory_impact	

$$\frac{n_{d,k} + \alpha_k}{\sum_i^k n_{d,i} + \alpha_i} \frac{v_{k,w_{d,n}} + \beta_{w_{d,n}}}{\sum_i v_{k,i} + \beta_i}$$

Starting with the left-hand side term in the equation, which seeks to provide a higher probability to topics prevalent in document d , $n_{d,k}$ is the words in document d associated with topic k , which is normalized by the number of words in the document. The α term is a Dirichlet parameter and this allows topics that have not appeared in the document, d , to have a non-zero probability.

The second term in the equation provides the word a higher probability of being associated with a topic if it is associated with that topic in other documents. $v_{k,w_{d,n}}$ is the number of times the word is associated with topic k in other documents normalized by how many times the word is assigned to any topic. The β term is a second Dirichlet parameter and this allows words that have not been associated with the topic previously to have a non-zero probability.

With the conditional probability distribution defined for the word across the K topics, a new topic for the word in document d is sampled (and accepted if the associated probability is higher than a random draw from a multinomial distribution). The process then iterates over words and documents.

Chapter 6

Conclusion

6.1 An overview of our key results

Since the Global Financial Crisis, much effort has been put into measuring uncertainty and quantifying its effect on the business cycle. This line of research is important, but the sole focus on the business cycle and uncertainty has overlooked the concept of uncertainty coming from the formal institutions of a country: its laws and regulations (amongst other things). This type of uncertainty is ‘structural’ in nature and more amenable to being reduced by reform.

Although there is a lot more to be done on the topic (as we will discuss in the next section), this thesis has provided four contributions to the literature. The first is to argue that an important test of economic institutional reform success is not ‘improvements’ in GDP or any other macroeconomic or fiscal aggregate, but whether there has been a decrease in uncertainty. This is because the level of uncertainty is a direct result of institutional quality. Of course, these other aggregates might improve as a result of less uncertainty—the resultant higher investment might boost GDP, for example—but, and particularly in a small, open economy, these macroeconomic aggregates can also be impacted on by other events, such as slowdowns in productivity in export markets; this contaminates them as indicators. In chapters 2 and 3, using the controversial New Zealand economic reforms of the 1980s as a case study, we provide two examples of how to test institutional reform success in reducing uncertainty. Chapter 2 assesses the success of the general reform programme, while chapter 3 assesses the success of two pieces of significant legislation regarding fiscal policy. Both chapters find, using the tools of modern econometrics, that the New Zealand reforms can be considered successful when uncertainty is used as the success metric. To reiterate, our first research question was as follows: **Was New Zealand’s institutional reform successful in reducing uncertainty?** The answer based on our results in chapters 2 and 3 is: ‘yes it was’.

Our second contribution, this time in chapter 4, is to again revisit and provide new evidence on an old question: which historical monetary regime has resulted in the lowest level of uncertainty? This question has been taken up by a number of eminent authors (Meltzer, 1986; Bordo & Schwartz, 1999; Benati & Goodhart, 2010) who focus on the (unforecastable) volatility in numerical data. We use an alternative source of data—text data—over a longer time period. Our argument is text data more readily capture the subjective nature of uncertainty. In saying this, our key findings broadly confirm the findings of previous studies: the Bretton Woods regime had the lowest level of uncertainty; the gold exchange standard and the managed floating regimes, had the highest. We find, as others have, that the success of the Bretton Woods regime might reflect, in part, that the regime faced a less difficult external environment for policymakers to deal with (that is, it had more tranquil seas to navigate). Our third contribution to the literature, also in chapter 4, is to

show that different types of uncertainty are generally idiosyncratic to the monetary regime. The exception is, perhaps, the interwar regimes where there appear to be significant commonalities in terms of the types of uncertainty; in our opinion, this reflects, in part, a flawed informal institution: central bank co-operation. We posed our second research question as: **do different monetary institutional regimes result in different types of uncertainty?** Based on our analysis, we conclude, in the case of the United States and the United Kingdom is ‘yes (excepting perhaps the interwar regimes)’.

Narrative approaches to identifying structural shocks have become popular in vector autoregression literature since the papers of Romer and Romer on monetary and fiscal policy (see, for example, Romer & Romer, 1994, Romer & Romer, 2010). Our final contribution, as set out in chapter 5, is to show how shocks can be narratively identified when the underlying text data is voluminous and unstructured. Again, using New Zealand as an application, the paper takes advantage of the institutional reform period as a source of exogenous (policy) uncertainty. Our text-mining based procedure, reassuringly, identifies a number of quarters in the reform period where uncertainty shocks can be plausibly classified as exogenous to the business cycle. In terms of our results, we show that uncertainty shocks identified via our method have larger impacts on macroeconomic variables than shocks identified using the more common, recursive approach to identification. All of the studies to date looking at the impact of uncertainty on the New Zealand economy have used the recursive approach (Kamber et al., 2016; Greig et al., 2018; Tran et al., 2019; Ballingall et al., 2020). Our results suggest, therefore, that the impacts of uncertainty have been understated previously. So **can we use the fact—that in some time periods, institutional change might induce uncertainty exogenous to the business cycle—to better identify uncertainty shocks and, thus, better understand the impacts of uncertainty on the economy?** Obviously, the term ‘better identify’ is subjective and thus it is harder to be definitive on the answer to this question. However, as we argue in the chapter, we feel our methodology is less prone to producing estimates of the impact of uncertainty that are subject to attenuation bias, so we can (tentatively) answer the question in the affirmative.

6.2 Further research

We believe the institutions-uncertainty relationship is a rich seam of further research waiting to be mined. Like the Newcomen engines, a 1712 invention that allowed English miners to pump water out of coal mines, facilitating deeper, and more profitable, coal mines; we believe the new methods for measuring uncertainty developed since the Global Financial Crisis will facilitate a deeper, and more profitable, study of the institutions-uncertainty link.

The first area is the most immediate and pressing. This is the area we talked about in the introduction: which aspects of institutional quality are the most important in explaining the cross-country differences in the level of uncertainty? If we are correct in arguing that GDP, and other macroeconomic indicators, are contaminated measures of institutional uncertainty success, the results of cross-country studies that have used them as a dependent variable need to be re-evaluated with uncertainty as the dependent variable. The benefit of such an approach is countries wishing to grow will have a better understanding of which aspects of institutional quality they should focus on.

Secondly, one of the hypotheses we developed in our PhD research proposal, but did not have a chance to explore, was the idea that poorly- or well-functioning institutions might play an enhancing or absorbing role respectively when the economy faces exogenous shocks'. As we noted in our proposal '[i]n a country with poorly-functioning institutions, there is unlikely to be a clear and transparent understanding about how government and other organisations will respond to unexpected events. The result is the expectations of firms and households about the future are: not tightly bounded ('well anchored'), highly unstable and respond dramatically to new information. That is firms' and households' expectations of the future are uncertain and this uncertainty will rise when uncertainty about external events increases. Developing a model where the transmission of global shocks to uncertainty in the domestic economy is state dependent (with the states depending on institutional quality) appears a worthwhile endeavour for evaluating the success of institutional reform. The cross-country studies of Carrière-Swallow and Céspedes (2013) and Trung (2019) are a start in this direction.

Other future research we wish to propose relates specifically to the papers contained in this thesis. In chapters 2 and 3, we offer a method for recovering institutional uncertainty shocks. To test the robustness of this approach, there appears merit in estimating a structural model, for example, a Dynamic Stochastic General Equilibrium model, where institutions are incorporated and can generate policy uncertainty. We could then use the data generated from the structural model where there has been an institutional change imposed, and see if our empirical models can recover similar responses of uncertainty to institutional quality. Mumtaz et al. (2018) apply a similar methodology to validate identified credit supply shocks.

In chapter 4, where we examine if the types of uncertainty associated with each monetary regime are idiosyncratic, we were careful to note that some of the topics of uncertainty associated with the regime reflect the structure and constraints of the regime itself, while other types of uncertainty reflect events the regime has had to deal with. When testing our hypothesis—that different regimes will result in different types of uncertainty—we are really only concerned with uncertainty topics emanating from the structure and constraints of the regime itself. Using the methodology of Bayoumi and Eichengreen (1994) and Bordo (1995), we started to try and identify such topics by finding those more strongly correlated with demand shocks. However, equating all demand shocks as coming from the monetary regime itself is unrealistic. Further work to isolate (demand) shocks which are endogenous to the monetary regime is needed.

Finally, in undertaking our research for chapter 4 we have assembled a large database of newspaper articles. This opens up many exciting research possibilities. One that immediately springs to mind is testing how the topics of uncertainty changed when the United Kingdom entered the Exchange Rate Mechanism in 1990 (or when Ireland joined the Euro) against a synthetic cohort of other English speaking countries such as New Zealand, Australia, Canada.¹ This synthetic cohort can be used, via established methods in the causal inference literature (see Cunningham, 2021), to distinguish the effects of the regime itself on uncertainty versus external influences. A second possibility, given chapter 4 is a broad overview of a long span of history, is to use the corpus to examine, in more detail, specific historical episodes.

¹A number of other interesting episodes to explore are outlined in Baxter and Stockman (1989).

6.3 A final reflection

This thesis has examined, in various historical contexts, the institutions—uncertainty association. Although history does not repeat, it often rhymes. What then are the implications of our research for the present day?

Although, in general, we have focused on how uncertainty changes as institutions change, the evidence presented in chapter 2 suggests that heightened uncertainty can be the spur for institutional change. At present, reflecting the Covid-19 pandemic and the Russian invasion of the Ukraine, uncertainty, both in New Zealand and globally, is elevated. In the 12 months to February 2022, by one measure, global policy uncertainty has averaged more than two standard deviations higher than its historical mean since 1997.² This would suggest it is a good time to review (at the least) the key institutions that govern economic policy.

Which economic institutions to review, and in which directions they could be possibly modified, is a thesis topic itself. In the interests of brevity, and given this thesis has focused on New Zealand in the main, we offer two suggestions in the New Zealand context.

As humans increasingly interact with, and influence, the environment, more crises will arise; crises may be other pandemics, climate-induced disasters or one, or several, of a myriad of other possibilities. As with the Covid-19 pandemic, managing these crises will involve a number of trade offs: between human health and economic activity, between different types of economic and social activity, and between generations. This is to be expected. Luckily, economics provides (some) tools, such as cost-benefit analysis and its variants, for thinking about these tradeoffs. New Zealand's response to the Covid-19 pandemic, however, has been characterised by a lack of official cost-benefit analyses of response options.³ A charitable explanation is, perhaps, the speed at which the Covid-19 pandemic evolved meant this was not possible. We will leave it to the reader to articulate less charitable explanations. The danger, however, is in the event of a crisis, this becomes a new *norm*.

The costs of a lack of formal tradeoff evaluation becoming the new norm is compounded by the situation, as we have observed in the Covid-19 pandemic, when various representations are made, often via the media, by industries or organisations for either policy exemptions or government subsidies. Without cost-benefit analysis or other tools of the public policy process guiding, and acting as constraints on, politicians, it is political calculus rather than welfare economics (that is, 'the allocation of goods and resources for promoting social welfare')⁴ driving decisions. Such decision making is more opaque and thus uncertainty inducing. Any losses from this uncertainty (and sub-optimal resource allocation) are further exacerbated as bargaining for exemptions or subsidies incurs additional costs; not least of all, diverting the firm's attention from responding to the crisis through reorganising its activities. Our first suggestion is, therefore, restore the norm that all policy proposals are subject to a cost-benefit analysis. Further, build on the Treasury's CBAX template to ensure that 'first pass' cost-benefit analyses can be done quickly in the event of a crisis.

²See https://www.policyuncertainty.com/global_monthly.html

³As evidence see the response to an OIA for 'any cost benefit analysis done by or held within the Treasury or such work contracted by the Treasury related to the Covid-19 Alert Level settings and or New Zealand's border settings'. The response was: '[t]he Treasury does not hold a 'cost benefit analysis' which captures the entire response programme. Accordingly I am refusing your request under section 18(e) of the OIA – the document alleged to contain the information requested does not exist or cannot be found.' [<https://www.treasury.govt.nz/sites/default/files/2022-04/oia-20210489.pdf>]

⁴Definition taken from the 'welfare economics' entry on <https://www.investopedia.com/>

Our second suggestion relates to establishing rules and constraints (i.e. an institutional framework) when so-called unconventional monetary policy impacts on the Crown's finances. The Covid-19 pandemic has seen New Zealand adopt another monetary policy tool: quantitative easing (called the Large-Scale Asset Purchase, or the LSAP, in the New Zealand context).⁵ The actions of the Reserve Bank have always had an indirect effect on the Crown's finances via influencing the state of the economy (and thus taxation revenue and expenditure on automatic stabilisers). However, the LSAP, in conjunction with the Crown indemnity for any Reserve Bank losses incurred in conducting the programme, exposed the Crown's balance sheet to significant uncertainty, particularly as the Crown indemnity is unlimited. The uncertainty pertains to the possibility market interest rates increase faster than expected and the market value of the Reserve Bank's newly-acquired portfolio of long-term bonds falls. In this situation, the Crown, via indemnifying the Reserve Bank's losses, will make losses.⁶ Grant Robertson, the Minister of Finance, has described this as a 'risk worth taking'.⁷ That is fine, politicians are paid to make such decisions, and such decisions are always subject to uncertainty. But the hurdle of a 'risk worth taking' is a subjective one. The political economy literature warns us against the risks of giving politicians too much control over stabilisation policy in case they use it for electoral advantage. A future Minister of Finance knows without a Crown indemnity the Reserve Bank is unlikely to conduct quantitative easing. A future Minister of Finance also knows quantitative easing will boost the economy in the short run. These considerations might push a future Minister of Finance towards granting an indemnity, but at the expense of considerable uncertainty about the future state of the Crown finances. Therefore we propose that given unconventional monetary policy will become more conventional (as declining neutral interest rates make running stimulative conventional monetary policy more difficult in the presence of a zero lower bound), the Public Finance Act is modified to outline the circumstances for when it is appropriate for the Crown to indemnify the Reserve Bank. Further, limits to the Crown indemnity need to be established.

The LSAP also appears to lack an evaluative component from a fiscal point of view—it is hard to think that any other government initiative, that represented such risk to the Crown balance sheet, would not be subject to periodic review through a fiscal lens.⁸ Formal points of evaluation from a fiscal point of view need to be built into future legislation. Further, the Reserve Bank should be required to submit a plan for unwinding the programme when they are seeking indemnity approval. All these measures would reduce fiscal uncertainty.

To be clear, we are not saying that monetary policy should lose its independence (this is an important institution in and of itself) but when the Crown balance sheet is so directly impacted, there needs to be rules and constraints around the behaviour of all parties.

McDermott (2017) notes that economic policy uncertainty can be decomposed into extrinsic and intrinsic uncertainty. Extrinsic uncertainty stems from exogenous

⁵New Zealand has belatedly followed the path of a number of countries post the global financial crisis.

⁶In current pandemic, this situation has eventuated, costing the Crown around 5 billion dollars; see https://www.parliament.nz/resource/en-NZ/PAP_121244/82728da88f65502d4ab6e8eb2a88ad474ce10124

⁷<https://www.interest.co.nz/public-policy/115088/robertson-5-billion-bill-reserve-banks-bond-buying-programme-product-risk>

⁸It is true that the Reserve Bank do review the LSAP every time they conduct a monetary policy review but they only do so with an eye to achieving their objectives, not assessing the fiscal impact.

shocks/events, and policy-makers can do little about such uncertainty. Intrinsic uncertainty stems from policy-makers response to these exogenous shocks/events—particularly where there are ‘unclear policy-maker preferences over competing goals’ (McDermott, 2017, p. 104). It is this intrinsic uncertainty that is amendable to being reduced with better institutions. Above we offered two examples of where New Zealand’s institutions could be modified to reduce intrinsic uncertainty. And, if this thesis has established one thing, it is reducing uncertainty is worth it. The papers presented in chapters 2, 3 and 5 established that uncertainty (policy or otherwise) can have large detrimental impacts on GDP. And for all the criticisms of GDP as a measure of welfare/well-being, lost GDP still represents lost resources for us to live the lives we want.

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