Optimising Central Bank Behaviour

in a Stochastic Environment

with

Uncertain Credibility

by

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Abstract

Central bank credibility is defined for the purposes of this thesis as the belief held by agents that the central bank will not renege on its commitment to the specified monetary policy objective. Agents' perceptions on both the integrity and ability of the central bank to achieve and maintain price stability affect the determination of actual inflation via expected inflation. In the past, theoretical models have attempted to capture credibility effects through the application of game theory to assimilate the strategic interaction that occurs between the central bank, the government and agents. For the most part, these models are simple in structure and combined with the limitations commonly attributed to game theory have been heavily criticised. The results derived from empirical analyses of credibility have also been subject to debate due to the directly unobservable nature of credibility. In the past, such analyses have used a variety of measures to proxy credibility effects. While it is generally accepted that expected inflation would perhaps be the most accurate indicator, expectations are equally as subjective as credibility.

The results presented in this thesis are derived from simulations of the Reserve Bank's macroeconomic model used for forecasting and policy analysis (FPS). Given that the central bank faces uncertainty regarding its true level of credibility, it is necessary for policymakers to assume the level of credibility when formulating monetary policy. Depending on the specific disturbance that hits the economy, the combined effect of the bank's assumed and actual level of credibility can ultimately determine the success of the implemented policy. The main motivation of this thesis is to determine the extent to which the central bank benefits when it is aware of the fact it truly has credibility or whether the optimal policy response should always be based on the premise of no credibility.

In order to provide a more realistic analysis, stochastic simulations of FPS are used. In this case, the central bank observes a combination of five impulses simultaneously hit the economy in the current period and taking into account the effects of the impulses from previous periods, formulates monetary policy depending on its assumed level of

credibility. Despite the added dimension of uncertainty the central bank faces surrounding the occurrence of future shocks, the results indicate that the increase in output loss normally associated with a harsh policy response is minimal. By assuming a lack of credibility and thereby adopting a prudent approach to monetary policy, inflation variability is substantially reduced without any significant increase in output variability.

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Chapter 1

Introduction

In order to attain the objective of price stability, central banks will find it less costly if economic agents perceive the target to be both credible and achievable. As a result there has recently been a tendency among central banks to adopt clear and concise policy objectives, in particular the specification of a target band for inflation. However, at this point it is important to differentiate between the credibility of monetary policy and the credibility of the policy instrument. The former refers to the belief held by agents that the central bank will commit itself to the objective of price stability without the threat of the bank deliberately reneging on its commitment. The latter is concerned with the appropriate use and effect of the instrument used by the central bank to control inflation. The focus of this research will be directed towards the credibility of monetary policy and the inevitable uncertainty the central bank is forced to operate under when it is unable to determine its credibility as perceived by the public.

Intuitively, it may seem logical to assume that official forecasts on the state of the economy published by the private sector may be a fairly accurate indication of the central bank's level of credibility. However, forecasts of inflation do not provide information solely on the private sector's belief about whether the central bank is committed to its target or not. Forecasts will largely depend on the state of the economy as an aggregate, taking into account both current and anticipated shocks. The use of both forecast errors and inflation expectations as a proxy for central bank credibility have been popular measures for a great deal of the recent literature on the subject. However, the inappropriateness of forecasts and surveys of expectations as measures of credibility will be discussed in more depth in Chapter 3.

With particular reference to New Zealand, the Reserve Bank Act 1989 commits the Reserve Bank to achieving and maintaining "stability in the general level of prices" and in effect granted the Bank a larger degree of independence and prevention of direct intervention by the government. The Act, coupled with the Policy Target Agreement (PTA) which specifies the target band for inflation (currently 0 to 3 percent) provides

the primary requirement for credibility as a concise and transparent policy objective. The question as to whether the Reserve Bank has achieved credibility remains to be seen, if in fact this is possible to determine at all.

Given the vague nature of credibility and therefore the difficulty encountered when attempting to quantify it, the results presented in this paper are derived from simulations of the Reserve Bank's model used for forecasting and policy analysis (FPS). The results from five different shock experiments are analysed (aggregate demand, exchange rate, price, terms of trade and a foreign demand shock) and a comparison made between the effects of each individual shock and the combined effect of all five. The results will indicate the various reponses by the central bank in an environment where it faces uncertainty regarding credibility. Policy responses to various shocks will differ according to the particular level of credibility the bank assumes it has and the level it truly has.

Initially, this paper will follow the progression that research on credibility has followed over the past two decades. This starts with a discussion on the 'rules versus discretion' debate which for the most part provided the motivation for the subsequent research on central bank credibility. Chapter 3 will summarise the different types of measures that have been used to proxy credibility in recent studies, an issue that remains highly controversial. The next chapter will look at the effect on credibility from granting central banks independence from direct government intervention in the formulation of monetary policy. Chapter 5 discusses the possible motives for a central bank to renege on its commitment to price stability and the way in which specific incentives may prevent such behaviour. This is followed by a summary of New Zealand's recent history in monetary policy. Chapter 7 will include a brief outline of the Reserve Bank's model used for the credibility analysis with the following two chapters displaying the results from simulation experiments using the model. Finally, Chapter 10 will provide some concluding remarks.

Chapter 2

Development of the Theoretical Literature

2.1 The Rules versus Discretion Debate

The issue of central bank credibility has its foundations in the 'rules versus discretion' debate which was at its peak during the late 1970s and early 1980s. The most common approach to this problem was to construct theoretical models of reputation and delegation. The former took into account the importance of the establishment of a reputation by the central bank in order to achieve low levels of inflation and the latter assumed the delegation of policy making to conservative central bankers. From the 1970s onwards, inflation was considerably higher in the developed countries than was socially optimal. This led the new classical theorists in particular, to explore the dynamic inconsistency of low inflation monetary policy creating an inflationary bias. They suggested that inflation will occur even when the monetary authorities announce to the public that they are specifically following a low inflation policy. Higher levels of inflation will be experienced due to the way in which the rational[1] public will interpret these announcements. This particular issue was initially analysed by the influential paper of Kydland and Prescott (1977).

Kydland and Prescott (1977) argue that the implementation of discretionary monetary policy will lead to higher inflation without any compensatory increase in output. This is due to the fact that even though the public will be aware of the policymakers' preference for low inflation policies, the public will also know that the policymaker is likely to allow inflation to temporarily increase above its optimal low level so as to take full advantage of the initial expansion in output. The public will therefore anticipate higher levels of inflation and accordingly raise their expectations of inflation.

The opposition to discretionary policy is quite valid. Optimal control theory dictates that the 'best' decision will be selected given the current situation and taking into account past decisions. Expectations are completely disregarded despite the fact expectations themselves can have a significant impact on the success of any monetary

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[1] In the context of the Rational Expectations Hypothesis.

policy. Kydland and Prescott (1977) point out that control theory is unlikely to hold in reality since agents will most probably be aware to some extent of the way in which policymakers formulate monetary policy. Therefore, agents themselves will adjust their current behaviour in the event their expectations of future policies alter. While optimal control theory will produce the best decision given the current situation, such a decision will be sub-optimal and even destabilising so that the policymakers' objective of maximising social welfare will not be achieved.

Instead, Kydland and Prescott (1977) suggest that policymakers should base their decisions according to simple rules that are difficult to alter and are known and understood by the public. As an example they use the specification of a monetary policy rule in a legislative framework, in which case policymakers would only be able to change the rule by incurring considerable time and effort. Under such a rule, it would be possible to hold policymakers accountable, since any deviations or attempts to 'cheat' by the monetary authority would be immediately recognised by the rational public. As a result, credibility would be immediately established and even enhanced if the legislation were to additionally provide for the imposition of penalties in the event policymakers renege on their commitment.

Similarly, Barro and Gordon (1983a) identify a preference for policy rules over discretion represented by the inclusion of a separate expectations function in their model. In this case, expectations are dependent upon current information and are formed on the basis of the policymakers' decision rule which is universally known. Following the rational expectations hypothesis, there will therefore be no systematic forecast errors of inflation in equilibrium.

Barro and Gordon (1983a) specify three important advantages of policy rules over discretionary policy. Firstly, rather than act as unnecessary constraints on the policy options available to the policymaker, clear and concisely defined rules will ensure an easier way in which to monitor the monetary authority's behaviour and will act as a deterrent to undesirable actions being carried out by incompetent policymakers. Secondly, by imposing simple as opposed to complex policy rules or erratic discretionary policy, the ignorant portion of the public will also be able to monitor the

policymaker and form expectations accordingly. Thirdly, the security that a policy rule offers in terms of restricting future policy changes, enables agents to enter into long-term contractual arrangements without the threat of a significant loss in real monetary terms.

Barro and Gordon (1983a) claim that since a policy rule will be inherently credible there will be no need for an accompanying enforcement system. Combined with the presence of initial set-up costs associated with establishing a new policy regime including institutional and legislative changes, policymakers will have the incentive not to change policy rules for their own short-term gain.

The preference for a policy rule regime as opposed to discretionary policy for the purposes of attaining credibility has generally been accepted. In particular, Chari (1988) found the link between the expectations of agents and the history of past and current policies to be a very strong one. He also supported Friedman's (1960) view that discretion is unfavourable specifically in circumstances of imperfect information.

However, Fischer (1990) remains unconvinced of the superiority of rules over discretion despite the considerable amount of literature on dynamic inconsistency supporting the former. He believes that discretionary behaviour has been prevalent for an extremely long time and has the advantage of allowing for a certain degree of flexibility with respect to accommodating exogenous disturbances and achieving output stabilisation. Fischer states that there exists a continuum of monetary policy with differing degrees of discretion. He makes the valid point that a policy rule will hardly be effective merely because it is a rule; if it is inappropriate and not well defined it will produce undesirable economic consequences. Instead, Fischer suggests that attention should be directed towards evaluating alternative monetary policies rather than engage in the rule versus discretion debate.

2.2 Models of Reputation

Despite the criticism of the rules versus discretion literature taking a narrow approach to the debate, theorists continued to provide support for their preference for a policy rule. However, the focus of attention changed to centre around the notion that a policy rule

will be successful without the aid of supporting legislation due to the incentive held by policymakers to establish credibility. This led to the development of reputation models, largely instigated by Barro and Gordon (1983b).

They extended their positive analysis (Barro and Gordon, 1983a) by including in their model reputational forces, and as a result found that the optimal solution will be a weighted average of the rule and discretion outcomes. Therefore this solution will be superior to the discretionary outcome but inferior to the policy rule (or 'ideal') outcome. Similar to their original study, any shock that exaggerates the output gains from allowing inflation will lead to a higher growth rate of money and prices.

The monetary authorities will be successful in their attempts to expand output by creating unanticipated money shocks that temporarily raise inflation. However, Barro and Gordon (1983b) suggest that since agents are aware of the policy rule that the monetary authority is committed to, the agents will not systematically under-predict inflation. Over time, due to the strategic game-playing that occurs between policymakers and the rational economic agents, reputational forces will begin to affect decisions and may even replace the initial policy rules.

This informal enforcement mechanism is represented as the expected present value of the cost of cheating in the future. The length of the punishment interval for the monetary authority has been arbitrarily set equal to one period in order to enable the authority to restore its reputation. Overall, Barro and Gordon found that it will be optimal for the policymaker to implement a contractionary policy and to achieve and maintain low levels of inflation even when it becomes costly. This course of action is preferable in order for the monetary authority to build up a reputation that will ultimately have the effect of abating the public's reaction during a period of higher inflation if it were to occur in the future. The end result is that the policymaker will follow the predetermined rules in an effort to maintain their reputation without the aid of legislative constraints.

However, the validity of credibility serving as a sufficient disincentive to cheat has received some criticism. More recently, theorists claim that accompanying legislation is

necessary for the success of policy rules and should not be trivialised. With respect to Barro and Gordon's (1983b) analysis, the presence of multiple equilibria in their solution tends to imply that any desirable conclusion may be made (Rogoff, 1987). Similarly, the usual problems associated with theoretical and arbitrarily specified models also seriously undermines any conclusions made. Alesina (1988) agrees that the threat of a deterioration in reputation on its own is not a sufficiently strong enforcement mechanism and legislation should not only support the policy rule but it should also support central bank independence, an issue which will be explored in Chapter 4.

Backus and Driffill (1985a) build on Barro and Gordon (1983b) by incorporating uncertainty surrounding the central bank's preferences between inflation and output. Even if the central bank has no concern whatsoever for employment and output, any attempt to prove a strong anti-inflation stance to the public will be difficult. Backus and Driffill (1985a) go so far as to say that "Completely credible noninflationary policy is generally not possible" (p530).

In their model, Backus and Driffill (1985a) instigate a game between the government and the public.[2] The government can behave either highly conservatively (i.e. target zero inflation) or it may allow the economy to inflate at times in order to promote employment and growth. The public is unaware of which type of government is in power, in which case a weaker government has the opportunity to establish a reputation as long as it does not initially inflate. Both players select the optimal course of action given their opponent's selected course while at the same time, considering the effects such actions have on future reputation.

Backus and Driffill (1985a) represent credibility in their model by a probability determined by the public whether they believe the government is serious about its commitment to fighting inflation. They also attempt to develop a punishment strategy more realistic than Barro and Gordon's one period punishment interval, imposed by the public on the central bank in the case where it reneges.

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[2] Backus and Driffill (1985) assume that the government controls the formulation of monetary policy and hires central bankers (who may or may not share the government's preferences) to implement the policy.

Backus and Driffill (1985a) conclude that their sequential equilibrium[3] is just as good as simply targeting zero inflation in the event that credibility is low. Obviously the optimal solution would be a zero inflation policy which is fully credible and believed by the public. Therefore, regardless of whether a government is tough or weak with regard to controlling inflation, it will always aim to give the public the impression that they are committed to disinflationary policies at least initially, in order to establish a reputation. At the same time, governments will claim that the failure of such policies reflected as output losses and an increase in unemployment is due to the public's inability to form consistent expectations.

Similarly, even a tough government will experience losses in output for half the time if the public initially assumes they have a poor reputation. Also, weaker governments will induce recessions until the public becomes aware of the government's preference for output stabilisation and expectations eventually converge to actual inflation.

Backus and Driffill (1985a) make several suggestions as to how monetary policy credibility may be achieved. Firstly, governments (regardless of inflation-output preferences) should appoint conservative central bankers who have already built up a reputation of being strongly averse to inflation in order to reduce the uncertainty the public face with regard to the type of government which is in power. Additionally, they argue that in order to establish a reputation, the government should grant the central bank independence from government intervention in the formulation of monetary policy. Secondly, the credibility of a zero or low inflation policy will be almost guaranteed if the central bank is pre-committed by a legislated policy rule.

Several other theorists also extended Barro and Gordon's analysis so as to incorporate uncertainty regarding the preferences of the central bank. In an effort to conceal their preferences, central bankers are assumed to adopt 'noisy' policy making procedures. Canzoneri criticised Barro and Gordon's (1983b) model of reputation for producing an equilibrium which was too stable. In their model, inflation had stabilised at an optimal

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[3] Here, the government imposes an inflation surprise in period t, onto the public who revise their expectations from zero in period t, to the higher level of inflation in period t+1 and as a result output increases.

level once the central bank had established a good reputation. Canzoneri (1985) extended Barro and Gordon's model to show the important role private information has in causing periodic inflationary reversions. Furthermore, such reversions should not be interpreted as an indication of a deterioration in reputation or credibility.

Canzoneri defines private information as the monetary authority possessing more information relative to the private sector either on the state of the economy or on the authority's preferences. In the latter case, the monetary authority would somehow adopt 'noisy' policy-making procedures making it impossible for the private sector to be certain about the authority's preferences. This noisy monetary policy will work in the favour of the central bank as it enables policymakers to slow down the public's learning process of the central bankers' preferences and in turn allows them to impose monetary surprises at a time when the benefits to output are at its greatest.

Canzoneri finds that even where the monetary authority is in fact following its pre-committed policy rule, there will still be times where inflation reverts back to higher levels. This is because he assumes that the private sector will effectively have their own 'rule' of revising their inflation expectations upward if inflation exceeds a certain level. So that even if the monetary authority has no intention of ever cheating and the private sector is aware of this, they will none-the-less punish the monetary authority if inflation were to increase. This may occur due to imperfect central bank forecasts, from which policy actions are derived.

However, the way in which inflation expectations are formed in Canzoneri's model appear to be rather harsh. Punishment is carried out by the public, even though they are aware that the central bank would never renege. By revising their expectations upward whenever inflation exceeds their pre-determined acceptable level, the public punishes the central bank regardless of whether the increase in inflation was intentional or not. Therefore, it would seem that possessing a good reputation is not sufficient to maintain low levels of inflation.

While Canzoneri (1985) assumed the informational asymmetry to be an exogenous factor, Cukierman and Meltzer (1986) considered the private information held by the

central bank surrounding its preferences to be endogenous. Rather than claim that the central bank holds a preference for either stabilising output or stabilising inflation, Cukierman and Meltzer (1986) assume that the preferences of the central bank are stochastic. In an attempt to slow down the public's learning process, the central bank will adopt noisy monetary control. As a result, the central bank is able to create surprise inflation at times when output gains are the highest and surprise disinflation when these gains are low. However, Cukierman and Meltzer (1986) show that ultimately the central bank will suffer as imprecise monetary control results in an increase of inflation variance.

It would appear that the implementation of noisy monetary policy in an effort to mask preferences for stabilisation may not always be optimal. Canzoneri (1985) concluded that such efforts will prevent the first-best outcome from occurring due to the necessary reversions to higher levels of inflation. Therefore, noisy monetary policy will only benefit central banks that face continually high levels of inflation as opposed to those which have already established and maintained low levels of inflation.

Rather than analyse the uncertainty surrounding central bank preferences, Barro (1986) assumes that over time the public will eventually learn the preferences of the policymaker and so the uncertainty surrounding the policymakers' ability to commit to their objective becomes the issue of importance. Barro (1986) extends the analysis he carried out with Gordon previously by incorporating such a learning process. His findings are for the most part intuitive and not surprising. A low inflation equilibrium implies the benefits of establishing credibility far outweigh the costs of disinflating. Whereas an uncommitted policymaker will generate higher inflation in order to achieve temporary gains and the subsequent upward adjustment to expectations will deteriorate the situation.

Barro (1986) emphasises the distinction that his model deals specifically with a policymaker's ability to commit to their objective as opposed to whether they hold a preference for stabilising inflation or output. He notes that his approach may be of less relevance and that the latter approach has the appeal of involving institutional considerations rather than the competence of the policymaker. Despite this

shortcoming, Barro (1986) managed to avoid most of the problems he had encountered with some of his earlier models with respect to the presence of multiple equilibria and his solution had the added attraction of not depending upon an infinite horizon.

2.3 Models of Delegation

One of the seminal papers on the delegation of monetary policy (Rogoff 1985), suggested that the appointment of a conservative central banker with an aversion to inflation will substantially reduce the inflationary bias. However, while the conservative central banker will ensure low inflation, Rogoff claims that they will not respond well to exogenous shocks. In particular, the central banker will fail to adequately offset shocks to aggregate supply due to the inclusion of not only inflation but also employment in the social objective function. There will therefore be an optimal level of conservatism for the policymaker to possess. Realistically, this optimal level will be extremely difficult to determine and would necessarily be subjective.[4] Despite this, the notion that the appointment of a conservative central banker is a sufficient means to avoid dynamic inconsistent policy has received a considerable amount of support (Romer, 1996).

Eijffinger and Hoeberichts (1996) extend the Rogoff (1985) model in an attempt to determine the optimal degree of conservatism that central banks should aim for. They suggest that there is a trade-off between central bank independence and conservatism so that where monetary policy is largely at the discretion of the government, then the central bank will attempt to compensate by employing highly conservative central bankers. So that essentially, a more dependent central bank will be less committed to stabilising inflation.

The model developed by Eijffinger and Hoeberichts involves the minimisation of a social loss function which includes the optimal weight allocation of both central bank independence and conservativeness. The loss function consists of two terms, the first

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[4] Alesina (1988) commented that it may be the case political parties will need to compromise on their interpretations on an appropriate degree of conservatism for the central banker to possess. This could be a problem where one party is strongly averse to inflation and the other party shows a preference for output and employment growth.

being the inflationary bias which includes the independence and conservatism weights in its denominator so that it is assumed any inflation bias will be reduced by an increase in either of the two with the numerator including a proxy for the natural rate of unemployment. Eijffinger and Hoeberichts interpret this term as the credibility component of the social loss. Whereas the second term relates to the variance of output and can therefore be viewed as the flexibility component.

They found that where society's preferences lie with stabilising employment, the desired level of conservatism will increase. Intuitively this makes sense as inflation will be biased upwards as agents become focused on employment and in order to prevent any damage to credibility, the central bank will need to strengthen its commitment to maintaining price stability. Secondly and not surprisingly, where there is a high variance of productivity shocks, the optimal level of conservatism will be reduced as the central banker will need to be more flexible and less stringent on achieving lower levels of inflation. Thirdly, where the output gains from allowing inflation are high, so must the level of conservatism. This is simply because there will be a tendency among agents to generate inflation and as a result, low levels of inflation will only be maintained under a conservative central banker.

Herrendorf and Lockwood (1996) argue this point by also extending Rogoff's (1985) model and introduce delegation on the basis of either the stochastic inflation bias or on non-state contingency. The former refers to the situation whereby the private sector has more information than the central bank on a future supply shock which is then incorporated into their nominal wage settings. So that from the central bank's point of view, inflation will be stochastic and delegation will necessarily be contingent upon the information held by the private sector and not the relative conservatism of the central banker.

In the latter case, where delegation decisions are not dependent upon private information and are therefore non-state contingent (such as the setting of an inflation target), delegation to a conservative central banker will drive only the mean level of inflation to zero, not the variance. Under these circumstances, Herrendorf and

Lockwood (1996) claim it would be desirable for monetary policy to be delegated to a conservative central banker.

In contrast, Walsh (1995a) suggests that the increasing popularity of "inflation contracts" has tended to diminish the relevance of the literature favouring the appointment of conservative central bankers. Such contracts are offered to the central bank by the government specifying inflation targets in order to ensure commitment to pre-determined policy rules. In order to ensure compliance, the central banker will be provided with incentives to achieve the desired target and disincentives to cheat, in which case the dilemma of the credibility-flexibility trade-off will no longer exist. So that in effect, due to the increasingly held preference for such contracts, the literature which favours the assignment of an optimal weight on the conservatism of the central banker is of less relevance.

The studies mentioned so far have identified conservatism as a means to not only keep a tight reign on inflation but also in an effort to establish credibility within a shorter time span than a central banker who has a higher preference for output stabilisation. However, Dolado, Griffiths and Padilla (1994) claim that such delegation is necessary not only to establish credibility but more importantly, to effectively deal with the monetary spillover effects that occur between countries.[5] Abstracting from credibility, they analyse the effects of the delegation of a monetary policy to a conservative central banker in a multi-country context by constructing a two period game in which the government in each of the two countries selects a highly conservative central banker who then sets a money growth rate for their respective country. The implementation of monetary policy in one country is dependent upon the spillover effects such a policy has on the growth rate of output in the other country. Dolado et al argue that delegation will not necessarily be as a result of the incentive to attain credibility, but rather as a means to accommodate the spillover effects associated with foreign monetary policy.

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[5] Hamada (19876), a seminal paper on monetary policy co-ordination and spillovers using game theory, found that there will be a 'world inflation' bias if one country holds a preference for a current account surplus by way of a currency devaluation.

Due to the fact there will be a tendency towards implementing tight monetary policies by both countries, Dolado et al found that where there are positive money spillover effects,[6] the other country will necessarily carry the burden of extra inflation. Together with the conservative nature of both central bankers and therefore strict disinflation policies, social welfare in both countries will be reduced in terms of output foregone. However, in the case of negative monetary spillovers, delegation ensures that any small amount of inflation will be brought under control with little cost in terms of output so that welfare is improved across both countries.

Dolado et al also look at the case where a Supra-national Monetary Authority (SMA) sets the money growth rates for each country. Since the only way in which each economy differs is with respect to its own inflation-output preferences, Dolado Griffiths and Padilla show that in this case, each government will have the incentive to distort their true inflation-output preferences. For both negative and positive monetary spillovers, each government will pretend to be more averse to inflation than they truly are.

The main argument put forward by Dolado et al is that delegation will not always be welfare improving particularly when abstracting from the pursuit of credibility. At the same time it could be argued that to ignore credibility in the assessment of the effectiveness of monetary policy is a major short-coming of the paper. However, Dolado et al claim that is would in fact be possible to introduce aspects of credibility into their analysis and do so would in fact strengthen their results as long as the supply shocks were symmetric.

However, by incorporating both credibility and spillover effects, Laskar (1989) finds that the delegation of policy to a conservative central banker will improve welfare only when the shocks are asymmetric. Laskar (1989) uses a two-country model in order to analyse the effects of the strategic interaction (as opposed to co-operation) between the

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[6] A positive monetary spillover will occur where one country will experience a larger increase in output without any accompanying increase in their money supply following an increase in the money growth rate of the other country. Similarly, a negative monetary spillover will occur where one country will experience a decrease in output and will need to increase its own monetary growth rate following an increase in the money growth rate of the other country.

appointed conservative central bankers. Where negative supply shocks are symmetric (common to both countries), both central banks will have a tendency to implement expansionary monetary policies in an effort to boost employment. Although, such a policy will lead to an exchange rate depreciation and therefore create added inflationary pressures. As a result the conservative central bankers will have an incentive to limit the extent of their expansions, leading to a sub-optimal outcome.

In contrast, a conservative central banker will react favourably where shocks are asymmetric (relative shocks between countries). Laskar claims that under such conditions, the central banker will reduce the resulting exchange rate fluctuations in an effort to keep inflation under control. Due to Laskar's view that a stabilisation of the exchange rate can be interpreted as a public good, a more efficient outcome will occur favouring the appointment of a conservative central banker with a strong aversion to inflation.

Laskar warns that the current trend of appointing such conservative central bankers with the sole objective of inflation stabilisation may be unfavourable. Due to the fact countries are becoming increasingly interdependent and therefore vulnerable to the effects of policies implemented by other countries, the success of any monetary policy will be dependent on not only spillover effects but also on the type of shock which has hit the economy. Harsh monetary policies may be inappropriate and even detrimental under certain conditions. Furthermore, given the changing nature over time of the types of shocks which hit the economy, so will the optimal weighting between inflation and output stabilisation.

In light of the developments in Europe involving the formation of the European Monetary Union (EMU), models of delegation are now largely based on a multi-country framework. As Currie, Levine and Pearlman (1996) find that in their multi-country model, where there is no co-ordination of monetary policy between countries then the delegation of a conservative central banker will yield an inferior solution to the case where a discretionary policymaker is selected. It is due to exchange rate effects that conservatism of policymakers leads to a sub-optimal solution.

Their two-stage delegation game involved firstly, the independent and simultaneous selection by each country of the level of conservatism of the policymaker. And secondly, the independent and simultaneous selection of inflation rates by each central bank. The resulting inefficient Nash equilibrium implies that the delegation of a conservative central banker will be counterproductive and inferior to the discretionary outcome.

2.4 The Progression of Political Game Theory

It was only in the mid to late 1980s that theorists began to apply more advanced aspects of game theory into their analysis of central bank behaviour. As mentioned, simple game theory had been used to some extent in the earlier models (Kydland and Prescott, Barro and Gordon) but these models often produced more than one solution which had the added problem of relying heavily on the selection of time horizon.[7] This was mainly due to the fact that game theory in general had largely been developed for the purpose of analysing the behaviour between industrial organisations and so naturally, it was necessary to make alterations in order to accommodate the unique institutional framework in which central banks operate.

As the game theory on industrial organisation developed, so it did for central bank behaviour. Industrial organisation theorists, Milgrom and Roberts (1982) and Kreps and Wilson (1982) introduced the concept of uncertainty surrounding one player's objectives. This was translated to political game theory initially by Backus and Driffill (1985a) and Barro (1986) who both drew directly from Kreps and Wilson's methodology. The progression of political game theory was largely centred around such issues of uncertainty. In particular, the uncertainty surrounding a policymaker's preferences and ability to commit to their objective, uncertainty surrounding the objective itself, as well as analysing the role of private information with respect to both the forecasts and preferences of the central bank.

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[7] Barro and Gordon's (1983b) reputational equilibria was valid only over an infinite horizon. Friedman (1971) and Green and Porter (1984) encountered similar problems with the use of game theory.

In such models, credibility has for the most part, been represented by the probability, subjectively determined by the public, that the policymaker will be a certain 'type' or hold particular preferences. During the course of the game, the extent to which this probability will alter is dependent upon the particular policy actions the policymaker implements. Therefore over time, the public will observe the policymakers' actions and become aware of their preferences. However, the policymaker is aware of the public's learning process and incorporates this information when deciding on policy.

Such developments in game theory allow theorists to analyse the strategic game-playing behaviour between policymakers and the public, between policymakers themselves to the exclusion of the public[8] and more recently, between policymakers in different countries, taking into account the spillover effects of monetary policies between countries. Currently, the focus of political game theory has been used to examine the effects of policy co-ordination between countries, in the light of recent developments in Europe with respect to the impending monetary integration. For the most part, the literature analysing the effects of policy co-ordination between countries finds that institutional and policy credibility are essential for such co-ordination to be welfare improving.[9]

Alesina (1988) was also a main contributor to the development of political game theory. Specifically, Alesina (1988) criticised the literature for the use of a representative agent, typical in models of reputation and delegation and recognised the need to provide a more realistic model of policy decision making. The model that he developed enabled a policymaker to interact with the current and/or future policymakers and with the public in a strategic manner derived from game theory. The policymakers' behaviour is then determined endogenously depending on the policymakers' preferences, incentives and constraints. Alesina (1988) used his model to illustrate the point that in the absence of

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[8] Specifically, Tabellini (1986) analyses the strategic game-playing behaviour between the monetary authority and the government in order to determine equilibrium paths for money growth, fiscal deficits and public debt.

[9] Miller and Salmon (1985), Levine and Currie (1987), Currie, Levine and Vidalis (1987) and Currie, Holtham and Hallett (1989) all agree the role of credibility is important where policies are coordinated between countries. While Carraro and Giavazzi (1988) find that policy co-ordination will always be preferable, even in the absence of credibility or reputation.

complete central bank independence, inflation and output will become quite volatile due to the re-election incentive held by the politicians in power.

Obviously the validity and usefulness of the theoretical approaches to modelling central bank behaviour and credibility which has developed over the past decade is questionable. Criticism of the models mentioned have largely focused on the reliance on the rational expectations hypothesis and on the natural rate hypothesis. In particular, Taylor (1985) points out, if these hypotheses did in fact hold in reality, then there would be no trade-off between inflation and employment, in which case the central bank would simply be better off targeting zero inflation and implementing stringent monetary policies in order to achieve such an objective. However, it is widely known that one of the primary reasons central banks renege on their commitments to control inflation is to take full advantage of expansions in output and employment or to avoid recessions in the event output losses begin to accumulate.

Similarly, Rogoff (1989) also criticises the earlier models for relying on rational expectations and for the exclusion of governments indulging in strategic behaviour. Additionally, he claims that the more recent models which rely on the game-playing strategic interaction between sectors are most definitely an improvement particularly for their microeconomic approach to a macroeconomic issue.

While the application of game theory for central bank credibility analysis is particularly useful under conditions of uncertainty, there is just as much uncertainty surrounding strategic behaviour as there is on the exogenous factors which enter the model. The arbitrary nature of the theoretical models outlined certainly ensures that the practical implications of credibility are not accurately represented. This raises questions about the usefulness of the solutions produced by such models.

As mentioned, game theory itself is not immune to inconsistencies and problems with multiple equilibria and solution sensitivity particularly to the selection of time horizon, are frequently encountered. Specifically, Fudenberg and Maskin (1986) show that the informational sensitivity of the model solutions implies that any desirable equilibrium may be achieved depending on the initial assumptions surrounding the views of the

public. Similarly, the use of sequential equilibrium concepts prevents the automatic updating of beliefs if events occur that are not on the equilibrium path. In this case, it is also possible to select a particular set of beliefs in order to achieve a desired but misleading equilibrium (Driffill 1988).

The incorporation of punishment strategies into political game theory has also received some criticism. As mentioned, Barro and Gordon's analysis assumed that a loss in reputation suffered by the central bank if it were to renege was imposed for no longer than one period. Consequently, this punishment interval was extended by Backus and Driffill (1985a) for more than one period. However, the question remains as to what constitutes an appropriate and realistic duration of punishment. The central bank has every incentive to convince the public that it has a considerable amount to lose by reneging on its commitment in terms of a lengthy punishment interval. On the other hand, if the central bank were to cheat, policymakers would make every effort to convince the public that such an aberration would not occur again and that the punishment interval should be short (Rogoff, 1989).

The duration of a deterioration in reputation was not the only criticism associated with the inclusion of punishment strategies. Canzoneri (1985) assumed that the public would punish the central bank whenever inflation reached a certain level, regardless of whether the central bank had cheated or not. Likewise, the anchoring of inflation expectations following a reversion to higher inflation also creates problems. As Rogoff (1989) points out, a decision needs to be made on whether expectations revert back to their initial level or whether expectations settle at a slightly higher rate corresponding to a severe punishment strategy.

Cukierman (1992) opposes the inclusion of punishment strategies altogether for three reasons. Firstly, he attributes the common problem of multiple equilibria to the sensitivity of solutions to the punishment strategy assumed. In effect, this will prevent a unique solution from being obtained. Secondly, such strategies imply that inflation and expectations of inflation will be constant over time in equilibrium.[10] Thirdly, he claims

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[10] Goodhart (1994) comments that this criticism is perhaps naive as it rests upon the unrealistic assumption that the central bank has complete and instantaneous control over inflation.

that "the private costs of monitoring policymakers' actions are higher than the marginal private benefit" (p210). By making such a comment, Cukierman is therefore implying that the monitoring of central bank behaviour will always be imperfect despite the recent progression towards the formal independence of central banks governed by clear and concise legislated policy rules. It is surprising that Cukierman makes this comment given the nature of his work, a point noted by both Goodhart (1994) and Minford (1993).

There has also been criticism on the use of political business cycle models as a basis for comparison with monetary policy models. In particular, Driffill (1988) claims that such a comparison is not entirely appropriate given that the government has re-election incentives and will tend to inflate the economy and boost employment at the end of their term. Whereas central bankers have no such concerns about the end of the game.

The incorporation of realistic preferences held by both the public and policymakers has also been subject to debate. For the most part, political models assume that the public hold a strong aversion to inflation and care little about employment and output. This has usually been represented by punishment strategies the public inflicts on the central bank if it were to allow the economy to inflate. However, it is common knowledge that the public are concerned about employment and more often than not, central bankers spend a considerable amount of time and effort attempting to convince the public on the benefits of maintaining price stability in order to alleviate such concerns.

Similarly, there has been difficulty effectively representing the preferences of the policymaker. It has been argued that the maximisation of an arbitrarily specified social welfare function which forms the basis of most models analysing monetary policy is inappropriate. Typically, standard versions of the social welfare function specify an inverse relationship between welfare and inflation due to the lower value of real money balances held by the public, and a positive relationship between welfare and employment.

Cukierman (1986) claims that it is unrealistic to assume that policymakers are one of only two types and that the social welfare function is known only to the policymaker

and not the public. Cukierman (1986) claims that often the literature will downplay the relevance of distortionary taxes on the welfare function. He suggests that the presence of such taxes does not necessarily imply that the policymaker will hold an inflationary bias as assumed in the literature. Furthermore, he suggests that there may be two social welfare functions, one for the public and the weak policymaker and the other for the strong or conservative policymaker. The important point being that it is likely the policymakers objectives will differ from the social welfare function and therefore it would be more realistic to also consider a variety of objective functions from the policymakers' perspective.

Indeed, Friedman comments in Fischer (1990) that a more realistic representation of the policymakers objective function should include not only inflation and output deviations but also the avoidance of accountability balanced by the achievement of public prestige. Similarly, Willet (1990) suggests that not only should the policymaker's objective function be expanded to include their own personal objectives, but it should also include the personal objectives of a wider range of individuals. In particular, some consideration should be given to the rent-seeking and re-election incentives of fiscal policymakers which often have a significant indirect influence on the formulation of monetary policy.

More recently, the incorporation of incentive structures into central bank contracts suggests that the policymaker's objective function should also include weightings assigned to the specified rewards received by the bank in the event the target is achieved or penalties imposed in the event it is not. Svensson (1997b) claims that reducing the objective function to include only inflation and output deviations is limiting and unrealistic. Furthermore, the relative significance of incentive structures included in contracts to ensure policy objectives are achieved, tends to suggest that the allocation of a weighting on inflation stabilisation or the identification of conservatism is now of less importance than is usually assumed by the literature.

Realistically, there will be a number of considerations that should be included in both the social welfare function and the policymakers' objective function other than inflation and output stabilisation. It is likely that the policymaker will also consider credibility

repercussions as well in the maximisation of their own objective function. However, perhaps the most important consideration would be the extent of the central bank's co-operation with the government at both a formal and informal level.

Cukierman and Drazen (1986) claim that policymakers will determine their course of action depending on the amount of political pressure they are faced with. In particular, the government will have re-election incentives and the desire to adhere to their pre-election promises in order to establish a reputation with voters. It therefore follows that even if the central bank was formally independent through legislation, the central bank will none-the-less be subjected to the same political pressures due to the fact that the formulation of monetary policy often has to accommodate or at least take into consideration any expansionary fiscal policy which may have occurred.

As a result, there will always be uncertainty surrounding the government's actual preferences as opposed to their pre-election promises. Cukierman and Meltzer (1986) incorporate the public's uncertainty over the preferences of policymakers by assuming the government's preferences to alter randomly over time. However, the concept of randomisation of policy actions[11] has also received criticism for being unrealistic (Driffill 1988). Rogoff (1987) dealt with the randomisation problem by including a number of different types of policymaker, with each being distinguished by the degree of punishment they would endure if they were to renege on their commitment.

There has also been some question on the timing of the credibility problem. Some of the earlier models (Backus and Driffill 1985a, Barro 1986) consider the credibility problem to be relevant only for policymakers who are nearing the end of their term and do not suffer an enduring punishment. Driffill (1988) claims that realistically, credibility will only be an issue for new regimes and once a reputation is established, credibility should be of no concern ever again. Backus and Driffill (1985b) interpreted a credibility problem which exists at the beginning of a new regime being a result of the uncertainty surrounding the public's and the policymakers' objectives. The central bank targets zero inflation since it anticipates the formation of high inflation expectations by

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[11] This type of randomisation has been used by Backus and Driffill (1985) and Barro (1986).

wage setters. Therefore the game will begin with the economy experiencing a recession which will last until either the wage setters deem the monetary policy to be credible and lower their expectations accordingly or conversely, if the central bank suffers higher inflation in order to return permanently to full employment.

There has been some effort made to empirically test the theoretical models which analyse central bank credibility. Obviously this will be a difficult task given the subjective interpretation of credibility. For the most part, the models outlined have been relatively simple by including only a few key macroeconomic variables. As a result, the interrelationships and transmission mechanisms which occur between other macroeconomic and in particular, microeconomic variables will be ignored. Similarly, the fact that these models are analysed in only a static environment is also a severe limitation. The various ways in which theorists have attempted to empirically test central bank credibility and the reasons why these approaches may be misleading will be discussed in the next chapter.

Chapter 3

Development of the Empirical Literature

Due to the arbitrary nature and limited practical application of theoretical models and of game theory, there has been a tendency in the recent literature to seek a more precise and realistic interpretation of credibility in order to provide some empirical support of such models. Obviously this will be a difficult task given the limited number of useful observations. Changes to a country's institutional and government framework are infrequent with the most relevant changes, such as the introduction of central bank independence and the imposition of specific legislative policy objectives, occurring only in the past decade or so. This is combined with the fact that the concept of central bank credibility has been interpreted in several different ways over the years.

This chapter will outline the various proxies that have been used to represent credibility in the literature to date and why such proxies may be inappropriate and misleading indicators. The inability to realistically provide a precise and definitive measure of credibility provides the motivation for the methodology used in this paper. It is more likely than not that the construction of econometric models using actual data to determine credibility will provide spurious results due to a lack of observations, degrees of freedom problems, existence of 'noise' and subjective proxies for credibility.

3.1 Inflation Expectations

More often than not, theorists will tend to interpret movements in expected inflation as an indication of whether the public believes the central bank to be credible in its commitment to fighting inflation. However, the relationship between credible monetary policy and low inflation expectations is for the most part theoretical. There are many factors that affect expected and actual inflation other than the public's opinion of the competency of central bankers. Expectations of future inflation not only incorporate the probability of the central bank reneging on its commitment, but more importantly, agents' interpretations of the current state of the economy as a whole including the

effects of temporary disturbances and the interaction of many different variables, both at a macroeconomic and microeconomic level.[12] Furthermore, expectations also reflect the extent to which markets are imperfect and agents uninformed.

The application of theoretical models that consider expectational effects can be severely limited and dependent upon the particular method of expectation formation assumed. The adaptive expectations hypothesis was largely discarded by new classical theorists in favour of rational expectations which assumes agents have full information regarding the structure of the economy. Needless to say, in reality it is unlikely that agents will have such knowledge, nor is it likely that expectations will be formed on a consistent basis given that agents may be either entirely forward-looking, backward-looking or some combination of the two.[13]

A more fundamental problem is the exact measurement of expected inflation. In an empirical sense, any analysis involving inflation expectations will necessarily depend upon the source of the data. Often there will be several expectations surveys that are carried out by either government agencies or private sector forecasters. These surveys will differ mainly in three respects. Firstly, participants will vary between surveys and it may be the case that the expectations of one sector may subjectively be given a higher weighting in the economy-wide expectation of inflation. Often, surveys will consider participants from one specific group or sector only. In particular, some surveys focus on the expectations held by businesses or financial analysts while other surveys seek the views of the public at large. As a result, potential problems may arise due to the participants' lack of knowledge of the inflationary process or due to the availability of different information at the time of the survey leading to varying estimates. In general, financial sector participants will expect lower levels of inflation than the household

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[12] In an attempt to predict expected inflation, Madsen (1996) regresses expected inflation on actual inflation, real wages, the interest rate, labour productivity, both the world price of exports and non-oil commodities as well as real output. However, Madsen (1996) notes that the significance of some variables may merely reflect a spurious correlation with expected inflation rather than prove any predictive power.

[13] Madsen (1996) finds little support for rational expectations. This is due to the apparent inability of firms to consider in their expectations, temporary deviations of inflation from its long run equilibrium path. Instead, his results tend to favour the adaptive approach to the formation of inflation expectations. Similarly, in New Zealand evidence tends to support the adaptive expectations hypothesis with expectations being largely driven by recent inflation (McCallum, 1989).

sector and the labour market. McCallum (1989) found that the Reserve Bank survey of expectations, which consists largely of the views of the financial sector, reported a lower mean expected inflation rate than the National Bank survey.

Secondly, surveys may be either qualitative or quantitative with the former specifying the movement of a particular variable and the latter providing a estimate of the likely value of the variable in question. Qualitative estimates will have the problem of being too arbitrary whereas quantitative estimates will be subject to both measurement error and sensitivity to averaging method used.[14] In order to conduct an empirical analysis using expectations from a qualitative survey, some suitable method of quantifying these estimates is required. In which case any conclusions drawn from such an analysis should be met with some degree of caution.

Thirdly, surveys may differ with respect to the variable forecasted. There will inevitably be some variation of the particular measure of inflation participants will be required to forecast. This will also depend on the participants' understanding of what exactly defines inflation, in particular the questionable inclusion of interest rates. Similarly, it may be the case that surveys only consider the expected change of a nominal GDP deflator as a opposed to changes in the CPI.

King (1995) advises against the use of private sector forecasts as indications of expected inflation for two reasons. Firstly, it is often the case that only short-term expectations are considered over a time horizon which will most probably be shorter than the lag between policy implementation and the effects of the policy on inflation. Secondly, the expectations are usually formed for low time frequencies, either on a quarterly or annual basis. Therefore, it is difficult to determine the immediate effects of a change in policy or of an exogenous disturbance on expected inflation.

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[14] Specifically, Pesaran (1985) uses survey data to empirically test the way in which expectations are formed in British manufacturing industries. In some instances, the empirical tests produced spurious results which he largely attributed to the measurement errors inherent in the survey data.

Kahn (1995) assumes expected inflation to directly represent the credibility of monetary policy and that the inability of expectations to decrease is indicative of an incredible policy. However, the three expectations surveys he uses for his analysis give very different paths for future inflation. Two of these surveys were produced by private sector forecasters and are relatively close in level terms for their forecasts of inflation over a one year period. However, the same can not be said for their forecasted directional changes in inflation. The third survey whose participants are largely consumers formed inflation expectations which were consistently higher in levels terms and more volatile. Therefore, it seems questionable to conclude that the fact one survey predicts slightly higher inflation from one period to the next necessarily implies a deterioration of policy credibility.

In a similar report on the development of inflation, Clark (1996) claims that where expected inflation is close to (as opposed to lower than) actual inflation then this implies that "the public doubts the central bank will act to achieve the goal of reducing inflation . . . Thus, inflation expectations provide a useful indicator of monetary policy's credibility." (p32). This statement appears rather harsh since it would seem that in order to be considered credible, the central bank must ensure expectations are consistently lower than actual inflation. Obviously this is not a sustainable situation aside from the fact a very low level or zero inflation is not necessarily desirable.[15] Despite the central bank's best efforts, their lack of direct control over inflation implies that it is inevitable that higher levels of inflation will occur from time to time. As a result, such inflation reversions should not be interpreted as a lack of commitment by the central bank.

In several empirical analyses, the Phillips curve has been used to approximate the development of credibility over time. Perry (1983) states that the credibility hypothesis requires the coefficients in the Phillips curve to alter under consistent policy in the short run in order to represent both rapid disinflation and a higher decrease in inflation than increase in unemployment. However, Blanchard (1984) found that these coefficients to

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[15] Assuming expectations adjust upward in the following period in the event actual inflation does not reduce to last period's expectation.

be relatively stable despite whether policy was consistent or not.[16] Similar to Perry, Blanchard (1984) also attributes any potential change of the coefficients on lagged inflation, expected inflation and unemployment in the Phillips curve as the direct credibility effects of a policy change.

While cautious of his wage-price specification of the Phillips curve, Blanchard (1984) attributes the lack of response of wage inflation to changes in policy to either a lack of consistency in the way expectations are formed or alternatively, that expectations have little effect on wage inflation. Both interpretations seem to be counter-intuitive. Firstly, it would be unlikely that the same method for expectation formation would remain over such a long and turbulent period.[17] Secondly, it has long been established in economic theory that expected inflation is directly reflected in wage inflation as workers and employers supposedly incorporate their expectations when setting wages. While the usefulness of any conclusions will be dependent upon the data used to proxy expected inflation and therefore policy credibility, these results also question the direction and degree of causality between actual and expected inflation.

It seems questionable whether officially released figures for inflation expectations will adequately represent the view held by agents, on average, on the state of the economy. Therefore, the validity of empirical studies using inflation expectations estimates as a proxy for credibility is also open to debate. Nolan and Schaling (1996) claim that even theoretically, inflation expectations will be inaccurate whenever there is uncertainty surrounding the central bank's position on the output-inflation preference continuum. Furthermore, as a result of this uncertainty, it is more likely than not that expectations will be biased upwards.

It seems that agents' perceptions of the credibility of the central bank may not be the only component of expectations. A lack of knowledge surrounding monetary policy, inflation and the structure of the economy in general, measurement problems and the

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[16] Gordon (1980) and Schultze (1981) also found the inflation-output coefficients to be surprisingly stable over time even in the event of policy regime shifts.

[17] Blanchard (1984) estimated his wage-price Phillips curve for periods between 1964 to 1979 and 1983 in the U.S.

varying amount of information available at the time expectations are formed all affect the way in which expectations are estimated. It is due to the uncertainty surrounding the behaviour and formulation of expectations which seriously questions the validity of any empirical test which uses such subjective measures.

3.2 Long-term Interest Rates

Rather than use survey data for estimates of inflation expectations, many theorists have assumed in their empirical analyses the theoretical concept that higher expected inflation will be directly reflected as higher long-term interest rates. The intuition behind this relationship being the increase in compensation required by lenders due to an increase in the uncertainty resulting from higher levels of inflation. Therefore theoretically, an improvement in central bank credibility is translated into lower expected inflation reflected in lower long-term interest rates. Realistically this is not going to be the case. There are many factors aside from expectations of future inflation which affect bond yields. This is combined with the fact that there is a great deal of uncertainty surrounding the equilibrium value towards which the long-term rate converges therefore making it difficult to determine the significance of deviations when they occur.

While Nolan and Schaling (1996) use bond yields in their empirical analysis, they concede that such a proxy is a rather "crude" representation of inflation expectations (p27). In fact, in their attempt to find some meaningful relationship between their arbitrarily defined index approximating central bank accountability with expected inflation, their results are not only questionable but are also inconsistent. In their analysis of 14 countries, they find a positive relationship between the two variables. The interpretation offered by Nolan and Schaling (1996) is that any increase in accountability is solely an effort by central banks to reduce inflation expectations. With New Zealand falling in an area of both high accountability and high average bond yields this seems unusual. In theory, once a central bank becomes more accountable, expected inflation should become lower which would be reflected in lower bond yields, in direct contrast to Nolan and Schaling's (1996) findings.

King (1995) also uses bond yields as being representative of credibility in his empirical analysis. Due to his criticism of surveys and forecasts as indications of expectations as mentioned before, King (1995) interprets inflation expectations indirectly as movements in nominal and index-linked bonds. Specifically, King (1995) interprets monetary policy credibility as the difference between the distribution determined subjectively by the government with that determined by the private sector of the possible outcomes which may occur around the expected inflation rate. These possible outcomes are represented by the compensation or risk premium required by lenders for inflation.

King (1995) theoretically defines the components of the nominal forward rate as the expected real rate, expected inflation, the inflation risk premium and the real rate risk premium. The real forward rate, however, is the sum of the expected real rate and the real rate risk premium. Since King (1995) interprets credibility as the sum of expected inflation and the inflation risk premium, his estimate of credibility is the difference between the nominal and real forward rates. Further, he downplays the role of the risk premium by claiming that variations in the difference between the two rates is largely attributed to variations in expected inflation rather than due to variations in the risk premium.

King (1995) uses this measure to determine the credibility effects of four events, the United Kingdom's entry into and exit from the ERM, the 1993 budget and 1994 interest rate increase. Again, the conclusions drawn about credibility from movements in long term bond rates will be questionable. The way in which King (1995) has defined bond rates is a theoretical definition only. Empirically, it is not only difficult to determine real interest rates but it is also difficult to distinguish between the relative influences of expected inflation and the risk premium on the nominal-real interest rate gap. This is combined with the fact that it is highly unlikely that these four events were the sole determinants of movements in bond yields over the particular period in question and it may also be the case that these events had an effect only after a lag, the length of which would be almost impossible to accurately determine.

It is interesting that King (1995) notes the former point with regard to the significance of the events to affect interest rates. In fact he goes so far as to claim that conditions in

the global capital market is a far more important determinant of real rates than monetary policy credibility. He also states that changes to credibility will be difficult to detect since reputation will only improve at a gradual rate.

King's (1995) conclusions largely rest on his assumption that the inflation risk premium component is largely constant so that any movement of the differential between the real and nominal interest rates can be attributed solely to changes in expected inflation. He bases his supposition on supporting research by Brookes and Breedon (1994) and Barr (1994). In contrast, Söderlind and Svensson (1996) find little evidence to support the existence of a constant inflation risk premium. While they find that nominal interest rates and expected inflation are closely linked, Söderlind and Svensson (1996) claim that the use of judgement and the available information will only give some idea as to the reason for a shift of the nominal and real interest rate curves whether it be due to a change in the risk premium or to a change in inflation expectations. They add that there is little knowledge surrounding the behaviour and influence of risk premium and so it would seem unrealistic to merely assume that it is largely constant over time.

The purpose of the research carried out by Söderlind and Svensson (1996) was to determine the extent to which market expectations of future monetary policy can be inferred from the behaviour of interest rates. While they concede nominal and indexed bonds provide useful information about expectations, they are not so dismissive as King (1995) of the importance of survey data and commercial forecasts. More specifically they claim that market expectations for future short term interest rates (up until nine months ahead) are directly representative of market expectations of future monetary policy only when the short term interest rate is the policy instrument. Secondly, market expectations for future medium and long term interest rates (from two or three years onwards) are useful indicators of expected inflation especially if the central bank has an explicit inflation target. In this case, Söderlind and Svensson (1996) claim that the gap between expected inflation and the inflation target is a direct measure of monetary policy credibility.

Again, it can be argued that there are other factors that affect both short and long-term interest rates, nominal and real, other than expectations of future inflation. Factors such

as the liquidity preference of individual investors and the relative demand and supply of funds. Secondly, any measure of credibility that involves expected inflation is questionable for the reasons outlined in the previous section.

There has also been some suggestion that the relationship between interest rates and exchange rates implies the latter to also be a useful indicator for the credibility of monetary policy. In fact, Söderlind and Svensson (1996) claim that in the case where the exchange rate is expected to depreciate, then expected inflation is likely to be higher and therefore credibility lower. However, as mentioned before high inflation expectations may not necessarily be a reflection of the public's belief on whether the central bank is committed to its target. Secondly, as Söderlind and Svensson (1996) themselves note, expectations of exchange rate fluctuations should be considered with caution as there is a limited amount of empirical evidence supporting such estimates.

Furthermore, Söderlind and Svensson (1996) comment on the attempts that have been made to construct distributions of both the expected exchange rate and the interest rate in order to obtain a distribution of the expected monetary conditions index (MCI). Such an index is an attempt to provide an approximate indication of the effects of monetary policy. Again, problems associated with the measurement of expected exchange rates and expected interest rates and their associated distributions are quite evident as well as the presence of other factors affecting both exchange rates and interest rates questioning the usefulness of such an index.

The important point made by Söderlind and Svensson (1996) is that it is crucial central banks do not become a slave to market expectations, whatever their method for extracting such expectations whether it be through changes to the differential between nominal and real interest rates, survey data or commercial forecasts. By following the market and the market simultaneously following the central bank, no unique equilibrium will be reached, if any at all. Additionally, not only are market expectations difficult to extract, the market itself does not always act in a rational manner. Speculation and inaccurate asset valuations can lead to irrational behaviour by investors. Instead, Söderlind and Svensson (1996) recommend central banks consider their own internal inflation forecast as the intermediate target for a path towards the official target and to

only use market expectations as one of many informational inputs. More specifically, market expectations should be used mostly as an approximate indication of the way in which prices and wages may be set.

Mishkin (1990) performed empirical tests on U.S. data in an effort to determine the informational content inherent in the term structure of both short-term and long-term nominal interest rates. He found that while short-term nominal interest rates contain almost no information regarding the path of future inflation, changes in these nominal rates do provide information on the term structure of real interest rates normally unobservable. In contrast, for long-term nominal interest rates there was some degree of information inherent indicating the path of future inflation but no information regarding the term structure of real interest rates.

However, Mishkin (1990) advises against the observation of nominal interest rate movements as a direct indication of expected inflation. This is largely due to the sensitivity of the coefficient on the slope of the term structure (beta) to changes in expected inflation, the slope of the real term structure and their correlation with each other. Any changes to these three factors for whatever reason, will necessarily alter beta and therefore the ability of nominal interest rates to predict expected inflation.

Similarly, Roley and Sellon (1995) state that while there is an almost direct relationship between movements in short-term interest rates and monetary policy actions, the empirical evidence to date has not been able to prove such a solid relationship between long-term interest rates and policy actions. Since long-term interest rates are theoretically an average of current short-term rates and expected short-term rates, Roley and Sellon (1995) claim that any changes in these two determinants will necessarily affect long-term interest rates. Obviously it will be difficult to determine the impact monetary policy will have on expected short-term rates given their unobservable nature and the fact that these rates are also influenced by other factors. Secondly, the degree of control any central bank has over actual short-term interest rates will be dependent upon the instrument used to implement policy. Similarly, short-term interest rates will also be affected by movements in other variables other than policy actions.

Therefore it is not surprising that the empirical literature to date has not been able to provide convincing evidence of the ability of long-term interest rates to accurately reflect expected inflation. It would be almost impossible to extract the expected inflation information component from long-term interest rates given the influence of a multitude of other factors such as the inflation risk premium, the expected exchange rate, the distinction between short-run and long-run inflation expectations as well as the uncertainty surrounding the equilibrium path of interest rates. Similarly, long-term interest rates are believed to be influenced also by the evolution of government deficits,[18] political risk and foreign interest rates, with the latter being particularly important for small, open economies such as New Zealand.

3.3 Inflation

It may seem logical to assume actual inflation to be a direct measure of credibility in terms of its deviation from an inflation target. However, while actual inflation is probably the most appropriate proxy for credibility out of the other measures considered, the occurrence of high inflation in a particular period does not necessarily imply a deterioration of the credibility of the central bank. Recall that Canzoneri (1985) attributed reversions to high inflation as a result of actual inflation exceeding a pre-determined arbitrary level set by the public in an effort to deal with their uncertainty surrounding the preferences of the central bank. In the event that inflation exceeded this level for whatever reason, the public would accordingly adjust their expectations upwards and actual inflation would spiral upwards. In effect, the public was punishing the central bank even when it showed no intention whatsoever to cheat on its own policy rule.

Similarly, Driffill (1987) also highlights the important role uncertainty of the central bank's preferences has in contributing to higher levels of inflation. When this uncertainty is combined with the public's inability to perfectly monitor the central bank's actions, periods of high inflation may not be indicative of a lack of commitment by the central bank. Once the data for actual inflation is released, the public would be unable to differentiate between the extent of the disinflation policy implemented by the

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[18] Eijffinger and Hoeberichts (1996) p10.

bank with any associated forecast error, the combination of the two possibly having a detrimental effect, if any effect at all, on actual inflation.

Empirical studies that attempt to analyse monetary policy credibility inevitably look for evidence of reductions in inflation as representative of enhanced credibility with the additional requirement of ceteris paribus.[19] Obviously, this will not hold in reality as conditions can not be held constant. There are many factors that can cause a temporary increase in inflation that may not necessarily be a reflection on the central bank's commitment to price stability. The existence of fiscal deficits implies an excess of government expenditure that in itself creates inflationary pressures within the economy that the central bank may not be able to anticipate when formulating monetary policy.

Similarly, a current account deficit may endanger price stability if any deterioration is driven by increases in consumption and investment. In particular, the purchase of imports by the government for large infrastructure projects or for defence purposes can substantially widen the current account deficit even further and fuel inflation. Furthermore, as the demand for overall imports rise, so will the prices of imported goods (and the prices of domestically produced goods which use imported intermediate inputs) therefore exacerbating the initial inflationary problem. Any current account deficit necessarily implies a capital account surplus and so some consideration must be given to the purposes for which capital inflows are being directed towards, whether it be increasing consumption or investment.

Expectations play an important role in determining actual inflation through the setting of wages and product prices by the private sector. As mentioned, such expectations can be misleading due to inconsistent formation, measurement and source. As a result of the uncertainty surrounding the direction and magnitude of causality between actual and expected inflation, it is therefore difficult to determine to what extent actual inflation reflects the true state of the economy as opposed to the beliefs of potentially uninformed survey participants.

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[19] Baxter (1985) p355.

It is inevitable that a completely committed central bank will encounter periods of high inflation from time to time not only due to inconsistent expectations but also as a result of imperfect forecasting. It is impossible to foresee all economic disturbances and events that are to occur two to eight quarters ahead. Since policy actions are based upon these necessarily imperfect forecasts produced by the central bank, inflationary reversions are more than likely to occur at some point.

An important issue for the central bank to consider would obviously be the optimal speed of adjustment back to a lower level of inflation. Most probably, it will be one quarter later that the central bank will observe actual inflation to have increased. A decision would need to be made on the appropriate timing of policy tightening. Immediate action and the resulting prompt disinflation (ceteris paribus) would no doubt strengthen credibility. However, such action carries the threat of a prolonged and severe recession resulting in a trade-off. The threat of higher unemployment and output losses will most definitely require consideration in the formulation of policy, now matter how inflation-averse the central bank claims to be. The fact that policy rules in their extreme form can not be time-consistent has been generally accepted. Therefore there will be a potentially lengthy lag between the observation of inflation, policy action and the effects of the policy. Matters will be further complicated by both the indirect control the central bank has over inflation as well as the continual influence other factors and economic variables will have on inflation during this period.

A more obvious problem common to almost all economic data is the accurate measurement of inflation. While actual inflation is not quite as arbitrary as expected inflation, similar problems exist with respect to the actual components of inflation and the way in which these components are aggregated to calculate inflation. Often under inflation targeting regimes, the supporting legislation will usually specify the exact definition of inflation in terms of the components or economic disturbances that are to be excluded. However, due to the fact there are a considerable number of components that constitute the Consumers Price Index, it is likely that the inevitable presence of large measurement errors and the selected method of aggregation will have distortionary effects. Also, over time some components will inevitably be removed from the index for whatever reason and others included which again causes problems with consistency.

The economy is continually subjected to all kinds of unanticipated exogenous disturbances both domestically and internationally induced. The latter is of particular relevance given the small and open nature of New Zealand's economy. These shocks will vary in frequency, duration and intensity depending on their source and on the initial state of the economy. Needless to say it is impossible to predict when and if these shocks will occur, whether they will be temporary or permanent and to what degree they will affect inflation. Again, the central bank's inability to foresee these events combined with a lack of direct influence over inflation and concerns for output and employment stabilisation will cause inflation to be higher at some time in the future and should not be interpreted as a lack of commitment by the central bank to achieving price stability.

3.4 Forecast Errors

Johnson (1997) is less cautious about his measurement of credibility by claiming that the deviation of forecasted inflation from the midpoint of an inflation target band is a "direct measure of credibility" (p10). He examines the forecasting errors of 18 countries over the period from 1984 to 1995 in an attempt to determine whether countries that have specific inflation targets are more credible than countries which do not.

The way in which theorists define credibility is a crucial point to consider when assessing the validity of their empirical (and theoretical) research. Johnson (1997) defines an improvement in the credibility of monetary policy as "a more rapid acknowledgement of the change in monetary regime to a lower inflation rate" and whether the specified inflation target is "believed by the rest of society" (p2). He goes further to claim that the success of monetary policy will also depend on the ability of the policy to maintain a level of inflation consistent with the inflation target as opposed to its credibility. Therefore it would seem Johnson (1997) does not associate credibility with the central bank's competency but rather on the central bank's integrity.

While this is the generally accepted definition, the way in which the public can indicate that they either "acknowledge" or "believe" an inflation target is open to debate. Johnson (1997) assumes that their acknowledgement is simply reflected as lower

inflation expectations. However, as mentioned before, periods of high expected and actual inflation may not necessarily accurately reflect the central bank's integrity or seriousness of their commitment to fighting inflation. By using Johnson's (1997) definition it would be technically possible for the public to have higher expectations but to still believe the central bank to be credible in terms of being unlikely to deliberately renege.

In order to account for the period prior to the implementation of inflation targets and for the countries that do not have specific targets, Johnson (1997) assumes credibility to be represented by the deviation of expected inflation from actual inflation. The possible reasons why these two variables may not be accurate indications of credibility have already been discussed.

Johnson (1997) assumes the inflation forecasts produced by professional forecasters to be accurate estimates of expected inflation. Obviously a cross-country comparison will be difficult to determine given that in some countries such as Ireland, only two different professional forecasters are considered, whereas in the United Kingdom there are 28. Furthermore, each country has a different proportion of their total forecasts that are produced by the public sector and the obvious informational asymmetries will necessarily affect the results. It is also questionable whether these forecasts produced by either the public sector or the private sector accurately represent the beliefs of society as a whole.

Matters are further complicated by the changing composition of the survey Johnson (1997) uses. During the period which Johnson (1997) considers, individual forecasters do enter and leave the survey. Additionally, where one forecaster produces more than one forecast per year, only the first forecast is considered so that each forecast of each individual forecaster that is considered in the analysis may be related to different times of the year. Johnson (1997) also notes that within some countries, different measures of inflation are forecasted but that this effect is negligible and so he does not make adjustments for this. Secondly, there will inevitably be data revisions in most countries that will necessarily affect forecasted and actual values over the 11 year period considered.

Johnson (1997) conducts his empirical analysis by assuming that the deviation of each individual inflation forecast from its target (or actual value where appropriate) is comprised of a credibility index and two error terms, one being the extent to which the forecaster does not believe in the official target beyond their usual level of disbelief and the other being the variation of forecasts around the average forecast. Johnson (1997) claims that the variance of the latter would be another appropriate measure of credibility.

However, there are two points to consider when using forecast errors or the variance of forecast errors as direct measures of credibility. Firstly, there are number of potential reasons why forecast errors may decline over time that are not necessarily related to the central bank's tendency to renege. Information and economic data is considerably more accessible and disaggregated than it was ten years ago and combined with the rapid development of advanced econometric techniques and associated software will necessarily improve the accuracy of forecasts. Secondly, any variation in the deviation between actual and forecasted inflation may cause the credibility index to fluctuate from time to time which would imply that credibility may be gained and lost several times during the year. As discussed earlier, the timing of the credibility problem and the establishment of a reputation has been debated by theorists extensively. It is generally accepted that central bank credibility evolves gradually over time and once lost, is very difficult to regain contradicting the findings of Johnson (1997).

Even Johnson (1997) himself questions the usefulness of forecast errors as representative of credibility despite his initial claim. He concedes that a small forecast error may not necessarily be a direct indication of the success of monetary policy. According to his definition, a combination of a low credibility index and small error terms will result in an accurate forecast. In intuitive terms, if society does not believe the announced target and if the central bank does not achieve this target on average for whatever reason then the resulting forecast error can be small.

Johnson (1997) does make an allowance for the fact in his analysis that it is possible for the central bank to have the ability to achieve targeted inflation yet may be unable to not because of an incentive to cheat but due to "year-specific" reasons. In fact, his results

indicate that this year-specific error term is highly significant across years in all countries. Again highlighting the reality of the difficulty encountered by central banks to directly control inflation.

Blanchard (1984) estimates an equation for long-term bond yields consisting of short-term rates and inflation for the U.S. for periods from 1954 to 1979 and 1983 in an attempt to determine the effects of policy changes on the formation of expectations. He interpreted the gradual decline of positive forecast errors of bond yields as an indication that initially the financial markets did not believe the promised disinflation would eventuate. Once the policy change was eventually believed, disinflation was not expected to be rapid. Whether conclusions can be drawn from these results on the credibility of the policy change is questionable. Not only is there uncertainty on the existence of a link between expected inflation and bond yields but also a gradual disinflation may not necessarily imply a lack of credibility.

Perry (1983) attributes the small under-predictions of inflation in his empirical analysis to the high elasticity of lagged inflation exaggerating the reaction of current inflation to its recent past. Despite this, inflation declined only gradually and combined with the relatively small forecast errors, Perry (1983) concluded that a credible policy does not necessarily require prompt and costless disinflation.

Madsen (1996) downplays the useful interpretation of the deviation of expected inflation from actual inflation. Specifically, he advises against the use of forecast errors as a direct measure of the rationality of expectations formed by producers. The reasons Madsen (1996) gives for his aversion is largely related to questionable conclusions drawn from statistical tests. Often, such tests will produce spurious results, suggesting causation between correlated variables when such correlation may be purely coincidental. While this criticism is largely directed towards the usefulness of econometric tests in general, it emphasises the caution required when performing any empirical analysis in an attempt to prove economic theory.

The fact that there is a great deal of uncertainty surrounding the precise measurement of both inflation and expected inflation and especially the subjective nature of the latter

seriously questions the usefulness of deviations between the two as a measure of credibility. Similarly, forecasts of inflation typically take into account the state of the economy, including both anticipated and current disturbances. So that in the event that forecasted inflation does not equal the target does not necessarily reflect a lack of central bank credibility, but possibly a recognition of the bank's indirect control over inflation.

3.5 Probabilities

A common approach of theoretical models is to assign a probability to represent the public's belief on whether they believe that the announced monetary policy will eventuate. Specifically, Baxter (1985) assumes that the public will determine this probability according to Bayesian properties on the relative success or failure of past and current policies. The essence of Baxter's argument is that the credibility of any monetary reform is dependent upon the mix of fiscal and monetary policies. As a result, she interprets credibility in her analysis as the subjective probability that two conditions will be satisfied. Firstly that the money growth rate is reduced as promised and secondly, the financing of the fiscal deficit will not result in an explosive path for public debt. Baxter uses this interpretation in an effort to determine the reasons for the relative success of stabilisation policies implemented in Chile and failure of similar policies in Argentina during the 1970s. She attributes the latter case to the damage to monetary policy reform caused by excessive fiscal deficits, highlighting the point that agents will consider both monetary and fiscal policies when forming their expectations.

Baxter claims that an improvement in the credibility of monetary policy should have the effect of reducing inflation and interest rates and increasing reserves and real money demand, ceteris paribus. This latter assumption tends to slightly discredit the results of the empirical analysis due to the fact that in reality, this condition will not be met as there are many factors other than credibility that influence these variables. Baxter recognises these limitations to some extent, conceding that the empirical approach she uses is not able to determine the degree of influence that credibility has on the success of monetary policy. As a result, Baxter confines her analysis to the interpretation of the correlation signs between the credibility probability and the variables mentioned. While

for the most part, the correlations proved to be intuitively correct, it is difficult to draw definite conclusions about the role of credibility due to the subjective nature of its representation as well as the limited application of the statistical methods implemented, a problem compounded by data anomalies and the simple nature of the model used for the analysis.

3.6 The Speed of Disinflation

Several theorists have claimed that a relatively accurate indication of central bank credibility is the time taken for inflation to decline to the desired level from the time the policy to disinflate is announced. Perry (1983) claims that in order to establish credibility, the central bank must achieve prompt disinflation. However as a result of his empirical findings he concludes that the implementation of a credible[20] disinflation policy does not cause inflation to decline at a faster rate.

Similarly, Posen (1994) claims that perfect credibility requires a disinflation duration of zero from the time the policy is implemented. He empirically tests his hypothesis that a credible monetary policy will induce a prompt disinflation. In order to proxy credibility, Posen's (1994) results rest on the questionable assumption that a high degree of central bank independence directly translates to enhanced credibility. He regressed the duration of disinflation on an arbitrarily defined central bank independence index and a constant.[21] Not surprisingly, the regressions produced for the most part insignificant statistics, a very low R^2 and negative coefficients for central bank independence.

An important distinction made by Posen (1994) is the fact that his hypothesis of credibility having the ability to speed up disinflation differs from the approach commonly taken in the literature. Sargent (1982) states that by actually taking steps to speed up the disinflationary process will in itself create credibility. Similarly, Ball

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[20] In terms of small forecast errors.

[21] Posen (1994) analysed the four main central bank independence indexes (Bade-Parkin 1985, Grilli-Masciandaro-Tabellini 1991, Alesina-Summers 1993, and Cukierman-Webb-Neyapti 1992) and selected the Cukierman et al index to use to test his hypotheses. While Posen (1994) claims the Cukierman et al index is the most appropriate as it is derived from a more detailed analysis, he adds that the results from his empirical analysis are largely unaffected when any of the other three indexes are used instead.

(1994a) outlines the relative costs of a gradual disinflation as opposed to a prompt disinflation. In an empirical analysis, Ball (1994a) found these costs will be smaller the faster disinflation. In an attempt to clarify the whole issue of the relative merits of a prompt disinflation with respect to minimising losses to output and whether it is true that these costs will be altogether eliminated under perfect credibility, Ball (1994b) illustrates theoretically how a prompt disinflation may actually result in a boom under conditions of perfect credibility and staggered price-setting. Similarly, some theorists believe losses to output may be completely avoided if the central bank allows a gradual disinflation whereas others believe an immediate disinflation will avoid such costs. However, both instances require the announcement to disinflate to be fully believed by the public and to therefore be perfectly credible. Ball (1994a) comments that it is unlikely this will be the case realistically, given that output losses will in fact occur due to the gradual adjustment of prices and wages and the likely existence of imperfect credibility. Blanchard and Summers (1988) claim that the presence of staggering ensures that these losses will always be incurred during a disinflation process.

The notion that a speedy disinflation necessarily implies a high level of credibility or alternatively, taking credibility as given, disinflation must be consistently prompt are both overly simplistic. The concept of an optimal speed of adjustment following a one-off shock regardless of credibility is a complicated and highly debated one. Following the announcement by the Bank of England earlier this year of their commitment to an inflation target of 2.5%, there was more concern expressed on the potentially harmful economic consequences resulting from an over-zealous interest rate response to shocks by the Bank than there was on the establishment of the Bank's credibility (The Economist 1997).

Indeed, the logic behind a more gradual disinflation following a shock is the minimisation of variations in output as well as in the policy instrument. It is for this reason Svensson (1997a) supports the gradual adjustment of the conditional forecast of inflation towards the official inflation target. Since the central bank can only implement policy based on expectations of future inflation, the model uncertainty associated with any forecast will necessitate some degree of caution in policy responses by the bank. In which case the conditional forecast could be identified as an intermediate target.

Svensson (1997a) claims this gradual adjustment to be even more crucial in the realistic scenario of imperfectly observed shocks whereby the central bank has limited information on the source and duration of an exogenous shock.

Similarly, Ball (1997) uses the Taylor rule to illustrate the way in which the optimal speed of adjustment may be derived by the selection of weights on output and inflation variances in the social welfare function. Ball (1997) claims that the introduction of an inflation targeting regime that allows for only gradual adjustments to shocks translates into an efficient Taylor rule. Obviously these theoretical approaches have certain practical limitations. Empirically, the derivation of an optimal speed of adjustment is impossible to determine. Not only will there be parameter uncertainty in the models used as a basis for the analysis, but the fundamental problem of associating variations in output and inflation with policy will be ever present. The direct observation of a small reduction in output per one percent decline in inflation (translated as a lower sacrifice ratio) may not be directly interpreted as a successful credible disinflation policy. Realistically, there will always be a multitude of factors affecting both output and inflation aside from monetary policy action.

Any evidence of credibility will most likely be reflected in the public's expectations of inflation. Given the ambiguous and subjective nature of expectations as well as the uncertainty surrounding the role of expectations in determining actual inflation it would be impossible to extract any information on credibility from merely observing either a particular measure of expected inflation or by observing how quickly inflation returns to target. Once the public eventually revise their expectations downwards following an announcement to disinflate, the extent to which their expectations contribute to actual inflation will have their impact only after a considerable lag given the variation in timing of wage contract renegotiations. Similarly, from a New-Keynesian perspective, firms may be reluctant to lower product prices and combined with the influence of market-specific factors, product prices may not decline at all.

Therefore it would seem the time taken for inflation to return to its target can not be interpreted as a direct measure of credibility. Indeed, the combination of the lack of direct control the central bank has over inflation, together with the lagged effect of

policy, the effects of further shocks occurring in the interim and other inertia existent in the economy implies that whenever actual inflation happens to coincide with the target is purely a chance event. When deciding how quickly to disinflate, the central bank should be concerned with not only maintaining its reputation as an ardent defender of low inflation but to also consider the current and expected state of the economy, including both the likelihood of future disturbances occurring in the short-term as well as any anticipated changes to fiscal policy.

3.7 Other Measures

Theorists have used a variety of other measures in their empirical analyses in an attempt to directly observe and quantify credibility effects. Regardless of the speed of disinflation, some theorists have argued that the actual size of the output loss resulting from disinflation is a direct measure of credibility. In fact, some of the pioneering work on credibility such as Fellner's (1976) Credibility Hypothesis was based upon the notion that enhanced credibility would lessen the severity of a recession following the implementation of a policy to disinflate (Perry, 1983 and Cukierman, 1986). Furthermore, the hypothesis requires that credibility can be established only if an extended slump is experienced following a disinflationary policy in order to prove the strong anti-inflation stance of the central bank. Recently, empirical studies have attempted to associate smaller output losses with enhanced credibility by calculating the sacrifice ratio. However, as mentioned in the previous section, it is difficult to draw definitive conclusions on the credibility or success of a disinflationary policy given the influence of other factors on the two variables as well as the obvious measurement problems.[22]

Another approach used to determine credibility effects is to examine the extent of nominal wage rigidity in the economy. Posen (1994) suggests that lower levels of inflation should generate greater nominal wage rigidity. By reducing the uncertainty surrounding future inflation, workers and employers will hold a preference for long-term contracts in an effort to reduce the costs associated with renegotiations.

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[22] Mayes and Chapple (1994) discuss at length the relative merits and short-comings of the sacrifice ratio as an appropriate indicator of policy success.

Posen (1994) extrapolates his hypothesis by assuming central bank independence is representative of low inflation and tests for evidence of a relationship between a central bank independence index and an approximation for nominal wage rigidity. Two measures of the latter variable are used as both are found to contain inconsistencies. Not surprisingly, given the arbitrary nature of the variables used, the results were counter-intuitive and from this Posen (1994) concluded that this was evidence that contracting behaviour is unaffected by the enhanced credibility provided by central bank independence. At a glance, such a conclusion seems quite impetuous given it assumes that not only does the mere introduction of central bank independence instantaneously reduces inflation, but that it also guarantees immediate credibility. This is aside from the fact that the conclusion is entirely derived from a failure to prove a correlation between two arbitrarily defined indexes.

In an attempt to determine the credibility effects resulting from the introduction of the Reserve Bank of New Zealand Act 1989, Kim (1997) empirically tests the influence government expenditure had on inflation during the period 1985 to 1996. The line of reasoning behind Kim's (1997) argument was that the partial funding of government expenditure by the Reserve Bank prior to the introduction of the Act of 1989 contributed to the implementation of time-inconsistent policy particularly leading up to elections. Kim (1997) estimated a quarterly monetary growth equation consisting of two independent variables, current government expenditure and inflation lagged one quarter. He found government expenditure to be insignificant and concluded that since government expenditure had not driven monetary growth between 1985 to 1996 then the Reserve Bank Act of 1989 can be perceived as being credible.

Kim's (1997) conclusion seems quite hasty given the simple nature of the model he used for his analysis. Any lagged effects of government expenditure on monetary growth are not accounted for as only the coincident value is included in the estimation. Similarly, only one lag of inflation is included, and it is surprisingly insignificant even at the ten per cent level. The exclusion of any proxy for expectations in the estimation is also of concern. These problems are exacerbated by the obvious data anomalies associated with any empirical analysis with respect to suitability and measurement.

A more fundamental flaw of Kim's (1997) analysis is the absence of an estimation for a sufficiently long enough period prior to the introduction of the 1989 Act. In which case, according to his hypothesis, it would be expected that the coefficient on current government expenditure should be highly significant. At a general level, it would seem the causality of government expenditure on inflation would be more representative of the effects of central bank independence rather than an indication of credibility. At the same time, regardless of central bank independence, the Reserve Bank will always need to consider to some extent recent and anticipated changes to government expenditure when formulating monetary policy in order to control inflation. It is therefore questionable whether the extent to which government expenditure determines monetary growth can be regarded as an accurate indicator of credibility.

Eijffinger and Hoeberichts (1996) assumed credibility to consist of three components; the natural rate of unemployment, the degree of central bank independence and the extent to which the bank is committed to fighting inflation or the level of conservatism. They rationalise their interpretation by claiming that a higher natural rate of unemployment translates into a higher rate of inflation which in turn leads to a deterioration in social welfare. According to their social loss function, this implies that the central bank is either not independent or not conservative enough or both. Eijffinger and Hoeberichts (1996) attempt to empirically determine the optimal degree of conservatism a central bank should possess in order to minimise the social loss function.

Obviously the validity of such testing will be questionable due to the difficulty involved in quantifying not only central bank independence and the natural rate of unemployment but also other variables used in the analysis such as the approximation of society's preferences with respect to output stabilisation. Furthermore, as Eijffinger and Hoeberichts admit themselves, these determinants will change frequently, while the actual degree of conservatism and independence will not change nearly as much. Eijffinger and Hoeberichts find that there exists a close positive relationship between their proxy for conservatism and long term interest rates. Even though long term interest rates have several different determinants other than the expectations of future inflation, Eijffinger and Hoeberichts conclude that central banks with higher degrees of conservatism will therefore be better off if they are granted more independence in order

to reduce expectations of future inflation. Although at the same time, the observation of high long term interest rates and high levels of conservatism could be alternatively interpreted as the inability of even strictly inflation-averse central banks to reduce expectations.

While most of the criticism on the empirical testing of credibility effects has largely been directed towards the limitations of econometric tests in general,[23] the ambiguous and subjective nature of credibility only serves to worsen the problem. Further, while expected inflation can be identified as probably the most accurate indicator of credibility, estimates of expectations are equally as subjective. Even though there will always be the temptation to look for evidence of credibility, realistically this is just not possible. Therefore it may be preferable to confine the analysis of credibility to theoretical models. However, in order to arrive at any sensible conclusions, such models must be comprehensive by considering more than a just a few key macroeconomic relationships. Indeed the simple nature of most of the models used for credibility analysis has been the main source of criticism of such models.

In order to fully understand the concept of central bank credibility and the way in which it may be either gained or lost, the next two chapters will look at the various factors that influence the development of credibility.

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[23] Driffill (1988) claims that the approach taken by theorists to empirically test for credibility effects uses only indirect testing and is generally not systematic. The most common approach being the identification of a breakdown once a new rule is introduced.

Chapter 4

Does Independence Guarantee Credibility?

Over the past decade there has been a tendency for governments to relinquish their control over the formulation of monetary policy and instead, to formally grant the central bank independence from government intervention. This was largely motivated by the high degree of inflationary bias experienced during the 1970s. Since monetary policy was determined by fiscal policy makers, inflation also tended to be highly correlated with political business cycles and therefore extremely volatile. Typically, just before election time, inflation would accelerate as the government in office would increase expenditure on social services and promote employment in an attempt to win votes. Following the election, the elected government would inevitably face the effects of a deep recession.

By creating an independent central bank, the formulation of monetary policy is delegated to policy makers who are concerned only with establishing and maintaining low levels of inflation and should therefore have no incentive to temporarily inflate the economy for re-election purposes. It is difficult to say conclusively whether the formalisation of central bank independence has in fact been the prime cause of lower levels of inflation given that central banks have been granted independence only in the last decade or so thereby limiting the number of useful observations for empirical testing. This is combined with the fact that lower levels of inflation may be attributed to a multitude of other factors and not solely the degree of central bank independence.[24]

Theorists have attempted to prove some type of causal link between inflation and central bank independence. Bleaney (1996) theoretically and empirically analysed the effects of central bank independence on inflation and unemployment across seventeen OECD countries. He concluded that independence has a strong inverse relationship with inflation and that low inflation is not necessarily associated with higher unemployment. Instead, he suggests that high rates of unemployment can be attributed to the

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[24] Such as the position of the government on the left-wing spectrum, changes to other institutional frameworks and infrastructure, employment relations and supply shocks (Alesina, 1988).

institutional framework of the respective country's labour market. Bade and Parkin (1985) found in their cross-country study an inverse relationship between inflation and central bank independence. Similarly, Posen (1994) was also able to prove such a relationship. However, these links may not necessarily be causal and may merely represent a spurious correlation between the two variables. Obviously such correlations will necessarily be questionable given the difficulty involved in proving causality combined with the subjective and unquantifiable nature of independence.

In contrast, Cukierman (1992) finds that there is two-way Granger causality between central bank independence and inflation only when independence is proxied by the turnover rate of central bank governors. Despite his findings, Cukierman (1992) remains cautious and reluctant to make any definite conclusions on the relationship between independence and inflation given the obvious measurement difficulties of the former.

It has also been suggested that the link between central bank independence and low inflation will be affected by the selected policy rule. In particular, theorists have claimed that the relationship between central bank independence and inflation will be weaker under a policy rule that fixes the exchange rate to a stable currency. Cukierman, Webb and Neyapti (1992) suggested that it may be the case that the exchange rate regime in place may have an effect on the relationship between low inflation and central bank independence. Anyadike-Danes (1995) empirically test their hypothesis on 44 developing countries that have either a pegged or a flexible exchange rate, or a combination of the two. In accordance with Cukierman et al (1992), Anyadike-Danes (1995) found that countries that follow a pegged exchange rate regime will have an inverse but relatively weak inflation and independence relationship.

The introduction of central bank independence was not only an attempt to stabilise inflation and to remove political cyclical influences, but to also establish credibility. It has been claimed that the mere instatement of independence should instantaneously create credibility. In other words, the legislation of central bank independence should be interpreted as an indication of the government's commitment to fighting inflation.

Posen (1994) made an attempt to find evidence of a relationship between central bank independence and credibility. In order to test his hypothesis that central bank independence will enhance credibility, he regressed the time taken to disinflate on an index of central bank independence and a constant. Needless to say, the results were spurious and counter-intuitive despite his findings in an earlier test supporting the inverse relationship between central bank independence and inflation. Assuming this latter correlation is causal and not a purely chance event, Posen (1994) concludes that perhaps central bank independence affects inflation through a mechanism other than enhanced credibility.

However, Posen (1994) does recognise the limitations of his findings due to their heavy reliance on arbitrarily defined central bank indexes. The construction of such indexes has received a considerable amount of justifiable criticism. The index used in Posen (1994) estimated by Cukierman et al (1992), is largely determined by the legislative framework governing the respective central bank. Typically this involves considering the appointment and dismissal of central bank governors, reporting requirements to the government and an interpretation of the objectives of the central bank. Needless to say, these variables would be difficult to rank in terms of relative importance, let alone quantify.

Forder (1996) raises some further important points to consider on the applicability of such indexes in empirical analyses. Firstly, it is unlikely that a central bank will be truly independent from the influence of the government. This is largely due to the fact that it is the government that has the ultimate power to determine the degree of independence the central bank should be granted. There has been a tendency for the literature to distinguish between instrument independence and goal independence.[25] The instatement of central bank independence usually refers to the former rather than the latter which remains under the domain of the government.

Secondly, there is an important distinction to be made between institutional independence and behavioural independence. While independence is supposedly a

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[25] Largely instigated by Fischer (1994).

mechanism to protect the central bank from the short run economic distortions created by government elections, monetary policy will none-the-less be effected. In most cases, the bank's desires and abilities under such conditions are not usually considered in the legislation. Instead, Forder (1996) suggests that central banks be ranked according to their ability to achieve long term objectives rather than look to the legislation as an indication of independence.

Forder (1996) implies that simply referring to legislation as a measure of central bank independence is a gross oversimplification due to the considerable amount of practical power and bank objectives that are not explicitly specified. It is unlikely that any statute will specify exactly who makes the policy decisions. It may even be the case that independence has been conferred but not in a formal legislative framework.

The relative importance of legislation governing central banks has been debated over the years. Initially, Barro and Gordon (1983b) suggested there was no need for legislation to ensure central bankers adhered to policy rules. Instead the informal incentive of policy makers to establish a reputation was considered to be a sufficient means to ensure commitment. Similarly, Blackburn (1992) argues that any improvement in credibility can be directly attributable to these informal incentives rather than as a result of any formal institutional changes such as an increase in central bank autonomy.

Waller and Walsh (1996) also downplay the notion of central bank independence creating credibility by highlighting the importance of optimal term lengths. Waller and Walsh (1996) claim that a central banker who is appointed for a long period of time will both reduce monetary policy uncertainty during periods of high government turnover as well as protect the central bank from political pressures. They base their theoretical analysis on empirical evidence suggesting a stronger correlation between the turnover rate of central bank governors and average inflation than any other measure of central bank structure.[26] Waller and Walsh (1996) also avoid any reference to legislation and instead, assume central bank independence to be determined by the term length of the

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[26] The empirical evidence is based on the findings of Cukierman et al (1992) and Cukierman, Kalaitzidakis, Summers and Webb (1993).

governor, the conservativeness of the central banker and the extent to which the central banker shares the government's preferences.

They find that where the central banker either shares the preferences of the government or is highly conservative so that output variability is high (in particular during election time), the optimal term length of the central banker should be increased in order to reduce policy uncertainty. Similarly, where there is considerable variability in the short run preferences of voters (resulting in high political turnover), the optimal term length should also be longer.

Therefore, the combined effect of an appointed conservative central banker (increases output variability) who is in office for a long period of time (reduces output variability) suggests that the correlation between central bank independence and output variability is zero. Waller and Walsh (1996) conclude that the lack of both theoretical and empirical evidence supporting a relationship between independence and output variation questions the validity of claims of a causal link between independence and inflation.[27]

Possible explanations behind the zero correlation between independence and output variation have been debated (Svensson, 1997b). It may be that central bank independence contributes to the stabilisation of output and employment as opposed to creating a destabilising effect. Similarly, increased monetary policy autonomy enables the government to focus more intensively on formulating fiscal policies that are specifically aimed at output and employment stabilisation. Further, the distortions that exogenous disturbances create can obscure any evidence of an underlying relationship between low inflation and output variation.

Due to the subjective interpretation of central bank independence and therefore the difficulty involved in quantifying such a variable, the validity of any empirical analysis suggesting evidence of a causal relationship between independence and inflation is questionable. In fact, the institutional design of the central bank would be irrelevant in

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[27] Alesina and Summers (1993) found in their empirical analysis that central bank independence reduces the level and variability of inflation but has little effect on real economic variables (output, employment and real interest rates).

countries where the preferences of the public sector and society as a whole were strictly inflation-averse and low levels of inflation continually maintained. Similarly, to attempt to obtain evidence of a link between central bank independence and credibility would appear even more difficult. Furthermore, it has been suggested that theoretical models should endogenise central bank independence in order to account for the long term evolution of an economy's institutional framework (Alesina and Summers, 1993 and Rogoff, 1988).

Intuitively it would not be unreasonable to interpret an increase in central bank autonomy as an indication of the government's commitment to achieving and maintaining low levels of inflation therefore leading to an improvement of credibility to some extent. However, at the same time independence does not necessarily translate into conservatism as there is nothing to prevent the independent central bank from opting to assign some consideration or weighting to output as well as inflation stabilisation. To claim that the conferment of central bank independence is both necessary to maintain low inflation and that it also leads to instantaneous and complete credibility would be a hasty generalisation.

Chapter 5

The Incentive to Renege

Central bankers have the incentive to renege on their commitment to price stability due to the time-inconsistency of policy. A pre-commitment to a specified policy rule will not always be optimal over time and central bankers will therefore face the temptation to cheat for their own short-term gain. While the formal specification of policy rules has become a popular trend among central banks in an effort to deter such behaviour and to also reduce uncertainty, the lack of flexible policy response which discretionary behaviour allows for is certainly a disadvantage. Never-the-less the various incentives of policy makers to renege have been viewed as potentially more harmful and seen as outweighing the benefits of flexibility. As a result, policy rules have tended to become more transparent and central banks more accountable. The following sections will initially outline the incentives of central bankers to renege on their commitment. Secondly, there will be a discussion on the way in which policy rules may be enforced in terms of incentives for compliance and penalties for non-compliance. Thirdly, there will be a brief outline of the nature and effects of monitoring central bank behaviour.

5.1 Incentives

5.1.1 Output and Employment Stabilisation

The notion that there is a trade-off between inflation and output in the short run, initially attributed to the New Classical school, is now generally accepted among most theorists as being valid. In the event of expansions to output, monetary policymakers have the incentive to allow inflation to increase temporarily above its target level in order to fully benefit from the economic boom. However, even in the event that the central bank announces to the public its commitment to a low inflation policy, inflation will increase further due to the way in which the rational public incorporates these announcements into its expectations. Despite the public's knowledge of the policymakers' preference for low inflation policies, the public will be aware of the incentive the policymaker has

to allow inflation to increase albeit for a short period of time. As a result, actual inflation will increase further as the public revise their expectations upwards.[28]

Similarly, any expansionary policy that raises output and inflation should theoretically reduce unemployment temporarily below its natural rate[29]. While firms will be able to charge higher prices due to the increase in the demand for goods and services and will be able to hire more workers, the resulting increase in employment will only be short-lived. Workers will be faced with a higher cost of living and will therefore demand higher wages. As firms experience these higher costs, unemployment will begin to increase and will return to its natural rate once workers have fully adjusted their expectations to the new higher level of inflation. Furthermore, there is realistically no guarantee that unemployment will decline in the first place given the uncertainty of the natural rate at any point in time.

In order to establish full credibility and a reputation for fighting inflation, it would obviously be in the central bank's best interests to never allow such inflationary pressures to accumulate. Regardless of central bank structure and efforts to enhance policy transparency, credibility is difficult to establish and easy to lose. In the event that policymakers reneged on their commitment and allowed higher levels of inflation, the resulting damage to credibility will have further effects on output and employment variability. The extent to which output will increase (if policy was eased during a boom) or decrease (following a policy to disinflate) will largely depend upon the formation of expectations. In the former case, gains to output will be small if expectations adjust rapidly to the new higher level of inflation. In the latter case, a lack of credibility will result in greater losses to output as agents will only slowly adjust their expectations downwards once they finally believe the central bank's announcement to

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[28] Kydland and Prescott (1977) claim that the benefits from an increase in output resulting in higher levels of inflation will only occur in a policy rule regime and not under discretionary policy.

[29] This assumes that the economy is initially at its natural rate of unemployment and that this rate is constant (i.e. there are no supply shocks or tax and transfer changes).

disinflate. In fact, theorists have claimed that it is the degree of credibility that will determine the size of the recession following a disinflation.[30]

The objective to establish credibility is not the only deterrent to temporarily allowing inflation to increase during an economic boom. The uncertainty surrounding the relationship between output and inflation implies that there is no guarantee further gains to output can be made if policy was inappropriately eased. Policy lags and the number of other factors that influence both inflation and output to differing degrees suggest that it is often uncertain whether such an easing of policy will have the desired effect. In fact, attempts to gain from temporary inflation are more likely to be destabilising to the economy. There are certainly non-trivial costs associated with higher levels of inflation both in terms of creating policy uncertainty and increasing inflation variability. By maintaining low levels of inflation and avoiding the temptation to renege, policy uncertainty will be reduced and the economy will remain relatively stable fostering long term economic growth.

At the same time, the implications of output effects can not be completely disregarded in the formulation of monetary policy.[31] An over-zealous commitment to reducing inflation variability is likely to have harmful economic consequences in terms of increasing output variability. The sustainability of economic growth is a concern of both the government and the public. More often than not, central banks will be criticised for stifling the economy and held solely responsible for increases in unemployment. In recent times, it has been somewhat of a public relations exercise for the central bank to inform the public on the costs of allowing higher levels of inflation versus the long term benefits of maintaining price stability. Never-the-less there will always exist a trade-off between establishing policy credibility and at the same time retaining some degree of flexibility.

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[30] See Cukierman (1986), Johnson (1997), Perry (1983) and Posen (1994). Ball (1994) claims that it is both credibility and the presence of price and wage staggering that will determine the amount of output loss following a disinflationary policy.

[31] Svensson (1997b) claims that in order to ensure an inflation targeting regime is successful, it is necessary for the central bank to at least have some systematic approach to determining an appropriate state-contingent employment target (usually equal to the short-run natural employment rate).

5.1.2 Accommodation of Fiscal Policy

Regardless of the degree of formal autonomy conferred upon the central bank, the formulation of monetary policy requires at least some consideration of any anticipated changes to fiscal policy. Indeed, it is this particular issue that questions the exact interpretation of central bank independence. While independence usually translates into the protection of monetary policy formulation from the direct intervention of the government, this does not necessarily imply a complete lack of co-operation between monetary and fiscal policymakers. With respect to New Zealand, Pollard (1993) interprets the Reserve Bank to be theoretically dependent, specifically due to this co-operation.

Even in the absence of any formal or informal co-operation between fiscal and monetary policymakers, the ability of either policy to produce the desired effect will necessarily depend upon the effects of the other. Despite the fact there has been an increasing tendency for central banks to be given autonomy over the formulation of monetary policy, Tabellini (1986) recognises that both the central bank and the government will have to consider the possible effects on the level of public debt when implementing fiscal and monetary policy. Tabellini (1986) analyses this policy interaction by way of a non-cooperative game played between the fiscal and monetary authorities to the exclusion of the public.

In his game, Tabellini (1986) specifies three decision rules, the monetary authority decides on the rate of money creation while the government decides upon the stock of nominal outstanding public debt and the level of the fiscal deficit. The game involves each authority optimising their position given their opponent's decision with no co-operation between the authorities nor any pre-commitment. At the same time, each player is aware of the fact that their current actions will necessarily impact future events, in particular the path for public debt. Overall, Tabellini (1986) finds the desired level of public debt will be achieved in a shorter time in the presence of policy co-ordination. The extreme case, where each authority is acting only according to their own objectives, significantly slows down the adjustment to the steady state level of public debt. In the

absence of co-ordination, allowing each authority to have the ability to pre-commit provides a compromise between the two outcomes.

Conversely, it has been argued that the amount of empirical evidence indicating a negative correlation between central bank independence and inflation and a zero correlation between independence and output variability implies that there is no link between fiscal and monetary policy. Grilli, Masciandaro and Tabellini (1991) claim that increased central bank independence will result in lower inflation with no systematic effects on output growth or its variability. Furthermore, this will be the case regardless of the government structure or existence of fiscal deficits. They attribute the presence of high levels of fiscal deficits and public debt as a direct result of the myopic behaviour of governments with short terms. Their conclusion seems rather premature given the lack of relevant data due to the relatively recent trend of granting central bank autonomy. Similarly, Grilli et al (1991) have been criticised for relying heavily on inaccurate data and on the particular econometric approaches used.[32]

In reality, it is unlikely that a central bank can ever be considered completely independent as it is the government that ultimately determines the degree of independence the central bank should be granted. Similarly, the central bank may be offered informal incentives to comply with the desires of the government. Typically this will involve concerns of the effects of tight monetary policy on employment and output growth, both of which are usually heavily weighted in the social welfare function of the government and the public.

Theoretical models that assume monetary policymakers maximise their own welfare have been criticised as being too simplistic. Willett (1990) claims that the formulation of monetary policy is more likely to be indirectly influenced by the self-interest and re-election motives of fiscal policymakers rather than of monetary policymakers. As a result, Willett (1990) suggests monetary policymakers should include in their objective function not only their own preferences and motives but also those of other rent-seeking individuals who are not directly involved in the formulation of monetary policy. This

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[32] This criticism is included as a part of the discussion on their analysis, appearing in Grilli et al (1991) pages 376-382.

tends to imply that monetary policy will be affected by not only the interdependence of the economic implications associated with the combination of monetary and fiscal policies, but also by the self-interest motives of both monetary and fiscal policymakers.

5.1.3 Seigniorage

Seigniorage refers to the revenue obtained by the central bank from printing money. By increasing the money supply, seigniorage revenues are increased to the detriment of price stability. The relative importance of the seigniorage motive for contributing to inflation is dependent upon the extent to which the government is authorised to borrow from the central bank. Obviously seigniorage will be more of a problem in countries that have fewer restrictions on the amount the government can borrow from the central bank in order to finance budget deficits. In this case, the issuance of government bonds is most probably quite limited particularly if the domestic capital market is relatively more risky so that seigniorage and tax revenues become the main source of deficit financing.

Creating unanticipated inflation enables the central bank to print even more money in order to replace the loss in real value of money held by the public. The extent to which seigniorage revenues increase will depend upon the speed at which the public's inflation expectations and money holdings adjust. From the government's point of view, surprise inflation will also lower the real value of government bonds currently held by the public which will therefore lower the government's future real expenditure in terms of interest and principal repayment. The budget deficit will be further reduced depending on the government's entitlement to seigniorage revenues generated by the central bank.

Cukierman (1992) empirically tested for evidence of the degree to which the pursuit of seigniorage revenues were directly attributable to periods of high inflation. He postulated that countries experiencing political instability were more likely to have inefficient tax regimes and would therefore rely heavily upon seigniorage as a source of revenue. Using data from 80 countries over the period 1971 to 1982, Cukierman's (1992) findings strongly supported his hypothesis that politically unstable countries were more likely to obtain a higher proportion of their revenues from less distortionary sources primarily, seigniorage. In effect, seigniorage will tend to be more of a threat to

price stability in developing economies or in countries were there is a relatively high level of tax evasion.

5.1.4 Balance of Payments

The balance of payments motive for creating surprise inflation is also perhaps less relevant for developed countries than it is for developing countries. In this case, the central bank directly intervenes in the foreign exchange market by devaluing the domestic currency in an effort to reduce a current account deficit. Obviously this will only apply to countries operating under a fixed exchange rate regime. Despite the recent trend for floating rate regimes, it is not uncommon for developing countries to at least initially peg their domestic currency against a relatively more stable currency such as the U.S. dollar in order to establish exchange rate stability and credibility.

Theoretically, a real devaluation of the domestic currency should lower the price of exports and assuming a high elasticity of demand for exports, improve the current account balance. However, the combination of relatively more expensive imports and the higher income associated with increased output, will fuel inflation. Realistically, an improvement in the current account is unlikely to occur given the uncertainty surrounding the elasticity of demand for both imports and exports and the fact that it is only possible for the central bank to directly control the nominal and not the real exchange rate.

In fact, as Cukierman (1992) notes, efforts to reduce a current account deficit via an exchange rate devaluation are rarely successful and only serve to create inflationary pressure. Similar to the dynamic inconsistency problem associated with disinflationary policies, central banks that indicate a concern for current account deficits will necessarily affect the public's expectations of inflation. Since the public will be aware of the bank's concern, they will anticipate devaluations and inflation in the event such deficits accumulate and will therefore demand higher nominal wages. So that ultimately once nominal wage contracts have been renegotiated, the current account deficit will remain while inflation will have risen.

The extent to which a central bank reacts to any one of these four incentives will necessarily affect credibility. Whether the central bank compromises its integrity out of concern for output stabilisation, fiscal policy effectiveness, seigniorage revenues or the balance of payments, the public will interpret such a concession as a lack of commitment by the central bank to price stability. As a result, inflation expectations will be revised upwards and over the long run both actual and expected inflation are likely to become anchored at consistently higher levels due to the difficulty involved in regaining lost credibility.

5.2 Accountability

Despite the claim of some theorists that the pursuit of credibility on its own is a sufficient enforcement mechanism to deter central bankers from reneging for their own short term gains, central banks have tended to take a more formal approach in order to provide some degree of accountability for their actions. It is now common for central banks to be governed and monitored under a legislative framework and to be ultimately accountable to the government. The effort to make central banks more accountable for their actions is in itself, an attempt to enhance credibility.

Due to the fact such legislation usually requires the central bank to explain the reason behind a deviation from target, the incentive of policymakers to cheat on the policy rule will be substantially reduced. More often than not, where these explanations are not adequate, the legislation will usually provide for specific penalties to be imposed on the bank in the event that there is evidence of deliberate non-compliance with the monetary objective.

Rather than look to legislation, more informal approaches to create accountability have also been used. It may be that the central bank is instead (or additionally) required to publish monetary policy reports or conduct public forums in order to justify their actions. Furthermore, the central bank will have the incentive to convince the public the considerable cost imposed on the bank if the target is not achieved in terms of lost credibility. Similarly, by also educating the public on the benefits of low inflation, the central bank will be able to influence expectations and therefore inflation.

The increasing trend of introducing monetary policy legislation has led theorists to attempt to determine the optimal contract that should be offered to central bankers in terms of the specific penalties that should be imposed or the provision for incentives that outweigh those to cheat in order to encourage compliance. Essentially, such contracts will confer instrument independence to the central bank but relatively less goal independence which remains under the ultimate discretion of the government. At the same time, the achievement of the monetary policy objectives as set out in the contract will not only depend on the incentive structure for compliance, but also on the credibility of the rule specified. In fact it is the latter from which the current literature analysing the determination of optimal incentives structures is derived.

Barro and Gordon (1983b) show that while a policy rule is always preferable to discretion, the central bank will find it optimal to cheat on the rule as long as the public expects compliance. This outcome is possible only if the public is continually fooled into believing the authority will maintain low levels of inflation. In the absence of any legislative enforcement mechanism to hold the central bank accountable for its actions, the central bank's incentive to cheat will ultimately determine which rule is implemented. However, this solution is dependent upon the arbitrary values initially assigned in the model to the probability that the central bank will cheat, the expected cost to the bank for cheating and the temptation for the authority to cheat, specified as the difference between the cost of cheating under a policy rule with that under discretion.

However, several theorists have shown that a central bank that is held accountable for its actions within a formal legislative framework will be punished whenever deviations from target occur. As mentioned in Chapter Two, Canzoneri (1985) claims that the central bank will be punished by the public regardless of whether the higher level of inflation was intentional or not. Under an inflation-targeting regime, Rogoff (1985) claims that the weight assigned to the inflation bias in the central bank's objective function will include a separate component representing the incentives (in terms of rewards or penalties) the central banker has to achieve the inflation target. By increasing the size of this component, the central bank will achieve a lower level of inflation while retaining the ability to respond optimally to demand shocks. However,

in the event that the economy experiences a supply shock, a potentially substantial cost will be incurred in terms of increased output variability.

Furthermore, Rogoff (1985) notes that in order for any targeting regime to be credible, some degree of flexibility is recommended in terms of the specification of a target band as the rigid requirement for the central bank to achieve the target exactly will not be optimal. Similarly, the specification of caveats, which largely involve the removal of volatile components from the price index measure used to calculate inflation, will also allow the central bank flexibility to accommodate one-off shocks.

Walsh (1995a) abstracts from the issue of optimal targeting rules and instead focuses on deriving the optimal contract. At the time, the literature analysing incentive structures for implementing monetary policy had largely revolved around assessing the effects of alternative targeting regimes. Walsh (1995a) claims that such an approach can cause some confusion given that it is difficult to differentiate between outcomes that are due to the particular features of the policy implemented and those that are due to sub-optimal targeting rules. Furthermore, it is commonly the case that targeting rules will be sub-optimal in the event of a supply shock. Assuming that both the government and the central bank share the same preferences and that both authorities will have their own motives to create inflation surprises, Walsh (1995a) analyses the optimal incentive structure that the government should offer the central bank in order to eliminate the inflationary bias while at the same time providing the bank with some degree of flexibility to respond to supply shocks.

The incentive structure Walsh (1995a) optimises takes the form of a state-contingent wage contract offered to the governor of the central bank. However, Walsh (1995a) recognises that such an incentive may in itself be sub-optimal but claims that it is a useful abstraction. Under the optimal incentive structure, Walsh (1995a) claims that the trade-off between credibility and flexibility disappears and the optimal contract ultimately indicates exactly how the targeting rules should be re-specified even where the central bank has private information. In fact, Walsh (1995a) attributes the credibility-flexibility trade-off to the sub-optimal incentive structure of targeting rules when used on their own.

Similarly, Persson and Tabellini (1993) also claim that the credibility problem will be eliminated if an optimal performance contract imposing a linear penalty on the central bank is offered by the government. In this case, the incentive to achieve the policy objectives is represented by the dismissal of the governor in the event they are not met. It is assumed that the governor has assigned a fixed cost to losing their job. The probability of dismissal increases the further inflation deviates from its targeted level. Since the contract is assumed to be negotiated prior to the formation of inflation expectations, there will be no inflationary bias even when the target is determined only by the government.

Subsequent to Rogoff's (1985) findings on the preference for conservative central banks, there has been some debate on the relevance of such delegation in light of the increasing trend to introduce inflation targeting regimes and performance contracts. Both Walsh (1995a) and Persson and Tabellini (1993) claim that delegation of monetary policy to conservative central banks is no longer necessary given the incentive structure that may be incorporated in inflation contracts to ensure central banks commit to the objective. Conversely, Herrendorf and Lockwood (1996) claim there is a role for conservatism despite the prevalence of such targeting regimes and contracts given the presence of a stochastic inflation bias. Similarly, Briault et al (1996) claim that a conservative central bank on its own, ensures low inflation in which case there is no need for accountability. While Svensson (1997b) finds that delegation on its own will only produce a third-best solution, but when combined with a state-contingent inflation target will produce a second-best solution.

Svensson (1997b) compared the relative merits of various inflation targeting regimes with contracts specifying performance incentives. Due to the presence of distortions, Svensson (1997b) outlines the alternative types of targeting regimes and contracts that will provide a second-best solution. A constant linear inflation contract under which the central bank governor receives a monetary reward for achieving low inflation will eliminate only the average inflation bias and not the state-contingent inflation bias nor

the stabilisation bias.[33] Svensson (1997b) notes that such rewards may also have political implications in terms of antagonising the public particularly if the attainment of the specified target results in persistently higher rates of unemployment. Similarly, the specification of a constant inflation target on its own will yield exactly the same results in terms of the elimination of only the average inflation bias.

A state-contingent linear inflation contract contains not only the cost of deviations of inflation from target (in terms of monetary rewards foregone) but also the marginal cost of inflation according to lagged employment. In this case, both the average and non-state contingent inflation bias and the stabilisation bias are eliminated even where there is employment persistence. Conversely, a state-contingent inflation target will not be successful in eliminating the stabilisation bias since the central bank is now responsible for stabilising not only inflation but also employment. Therefore, while employment will be stabilised following a supply shock, inflation will become more volatile. The stabilisation bias can only be eliminated if the state-contingent target is combined with a conservative central bank in order to reduce the resulting inflation variability. So that in effect, policy is delegated to a conservative central bank in an attempt to eliminate the stabilisation bias as opposed to reducing the inflation bias as initially proposed by Rogoff (1985).

Svensson (1997b) concludes that his theoretical findings have several empirical implications. Firstly, inflation rates should exceed their target at least on average. Secondly, lower inflation targets will necessarily translate into lower average inflation rates with no effect on output or employment variability. Thirdly, inflation targets will be imperfectly credible due to the fact expectations are more likely to exceed the targeted level. While empirical tests analysing the recent period of low inflation should be treated with caution given the limited number of observations, the evidence to date

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[33] Under an inflation targeting regime, there will be an implicit weight on employment stabilisation. The average inflation rate will exceed the explicit inflation target whenever the implicit employment target exceeds the natural employment rate resulting in an average inflation bias. This bias will increase whenever there is persistence in employment, that is when increases in current employment are likely to translate into increases in future employment. The temptation to raise current employment will also raise the average inflation bias. Furthermore, employment persistence will also create a state-contingent inflation bias since the deviation of the employment target from the short-run natural employment rate is state-contingent. The stabilisation bias represents the extent to which the inflation will be more variable in an attempt to stabilise employment (Svensson 1997b, p104).

has indicated a zero correlation between low inflation and output variability as already mentioned.[34] Similarly, Johnson (1997) finds that it is very difficult for a central bank to establish a credible inflation target regardless of band width and caveats. While forecast errors have over the past decade become smaller, Johnson (1997) remains reluctant to attribute this improvement in credibility solely to the introduction of inflation targeting regimes.

Despite the questionable accuracy of forecast errors as measures of credibility, Johnson (1997) finds that the inflation-targeting countries produce the highest forecast errors following the introduction of the regime. Further, whenever forecasts did happen to lie within the inflation band, this was largely due to the width of the band. Johnson (1997) rationalises his findings by claiming that countries that adopted an inflation-targeting regime were more likely to have a history of unsuccessful monetary policy and therefore it is not surprising such targets were not instantly credible. Instead, while Johnson (1997) claims that the introduction of targeting regimes enhanced credibility to some extent, the low levels of inflation experienced over the past decade are more likely a result of unexpected disinflations and a decrease in the variability of the year-specific component of forecast errors. Despite the lack of fully credible inflation targets, it is more than likely that inflation would have been higher in the absence of such regimes (Johnson, 1997; Svensson, 1997b).

While Svensson (1997b) found no difference in the effects of a linear inflation contract as opposed to an inflation target, Beetsma and Jensen (1997) find that the optimal linear inflation contract produces results superior to the optimal inflation target whenever there is uncertainty surrounding the preferences of the central bank. This is because the contract reduces the amount of inflation and output stabilisation that is directly attributable to uncertain central bank preferences while the target is successful in only reducing the inflation bias. Beetsma and Jensen (1997) find that the optimal strategy is a combination of the two, in which case the inflation bias will be eliminated as well as any variability not associated with supply shocks. The variation resulting from supply shocks is positively related to the uncertainty of central bank preferences. In which

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[34] See Alesina and Summers (1993), Waller and Walsh (1996), Beetsma and Jensen (1997), Grilli, Masciandaro and Tabellini (1991) and Persson and Tabellini (1993).

case, Beetsma and Jensen (1997) suggest the combination strategy can be improved on by introducing a quadratic performance contract whereby the central bank is punished according to squared deviations of inflation from target. So that in effect, the central banker will have more of an incentive to act conservatively which will reduce the uncertainty surrounding preferences and therefore output variability.

The issue of contract renegotiation is also of concern and has important implications for credibility and accountability. Walsh (1995b) has suggested an alternative incentive structure for contracts that provide for monetary rewards (either in terms of a state-contingent wage offered to the governor or in terms of a higher central bank budget allocation) based on inflation performance. Instead, the conditions under which the governor is initially appointed and subsequently re-appointed may provide a sufficient incentive structure. While the dismissal of the governor would ultimately remain at the discretion of the government, such an effort to create accountability must be enforced in order to enhance central bank credibility. It follows that the optimal term length of the governor becomes highly relevant in accordance with Waller and Walsh (1996). Obviously a longer term will necessarily have a detrimental effect on accountability while at the same time provide more independence from the government.

A more important issue is the possibility of a non-renegotiation-proof Walsh contract as examined by al-Nowaihi and Levine (1996). They claim Walsh's analysis of the optimal contract to be incomplete as the possibility of contract renegotiation is ignored. Full credibility will only be achieved if the optimal contract is protected from future changes or in other words, is renegotiation-proof. Where renegotiation is relatively costless, there will be circumstances under which the government or the central bank will seek to renegotiate. One such situation, which is the focus of the analysis of al-Nowaihi and Levine (1996), is in the event of a positive supply shock. According to the game specification set out in al-Nowaihi and Levine (1996), both the government and the public will have the incentive to prefer a contract renegotiation. While the contract would initially dictate a deflationary response to an anticipated supply shock, the government would prefer a neutral response given that it values higher output and zero inflation to a surprise deflation. Similarly, the public also prefer zero inflation to a deflation. The government can then offer the central bank an incentive to renegotiate in

terms of a monetary reward financed by the temporary increase in output. The possibility of such renegotiation is obviously to the detriment of accountability and credibility.

al-Nowaihi and Levine (1996) also briefly examine the effects of other possible incentives for contract renegotiation. Assuming that the government offers two types of contracts, one to an efficient central banker whose incentive structure is binding and therefore chooses the optimal level of effort and the other to an inefficient central banker whose incentive structure is not binding and whose level of effort will be accordingly sub-optimal. There will be a trade-off for the government to either reduce the economic rents allocated to the efficient central banker or to improve the conduct of monetary policy for an inefficient central banker. Therefore, once the central banker's type has been identified, the government will seek to renegotiate the initial contract. For the efficient central banker this will translate into a less than optimal incentive structure that will necessarily damage credibility.

Another situation for renegotiation exists where the central bank is risk averse. In this case, once the bank forms its forecast and prior to the observation of the shock, the central bank will have the incentive to renegotiate so as to transfer all risk to the government. Finally, al-Nowaihi and Levine (1996) consider, in the absence of contracts, inefficient punishments being inflicted by the government whenever the central bank reneges. Therefore, credibility will deteriorate as the public will become aware that the enforcement mechanism in place is relatively weak.

The relationship between central bank independence and accountability has also been the subject of debate in the recent literature. Persson and Tabellini (1993) claim that even a truly independent central bank will require some degree of accountability for its actions. Briault, Haldane and King (1996) interpret accountability as a means to balance the independence granted to the central bank in order to guard against a 'democratic deficit'.

Briault et al (1996) attempt to determine whether there exists a relationship between central bank independence and accountability given that in practice, central banks tend

to have varying degrees of the two. In order to do so, they claim that it is crucial to properly define the former in accordance with the distinction made by Fischer (1994) between goal independence and instrument independence. Goal independence relates to the central bank's degree of participation with the government in the determination of monetary policy objectives, most commonly the setting of an inflation target.

Intuitively, Briault et al (1996) claim that a central bank that has both complete goal and instrument independence should not require a great deal of accountability.[35] This is because an accountability constraint would have little effect given that the central bank sets its own goals. Furthermore, it is likely that a completely goal independent central bank would have initially proved itself to be strictly averse to inflation in order to be granted independence in the first place. Conversely, a central bank which has relatively less goal independence and may accordingly have some type of Walsh contract with the government, should have a higher degree of accountability.

Briault et al (1996) found this inverse relationship between goal independence and accountability to generally hold across a sample of 14 developed countries. They constructed an accountability index determined by the external monitoring requirements of the central bank to the government, the publishing of the minutes of monetary policy formulation meetings, the publishing of a monetary policy report and the presence of caveats, or an 'escape clause' in the event inflation exceeds its target. Similarly, their index of goal independence was constructed according to the legislated degree of independence conferred to the central bank, whether more than half of the appointments to the central bank board are determined independently from the government, the presence of government officials on the board and whether the central bank independently sets its own goals.

By plotting the two indexes against each other, the resulting negative correlation supported the intuition of Briault et al (1996) and tends to suggest goal independence and accountability serve as substitutes rather than complements. Briault et al (1996) put forward the alternative explanation that central banks that have established a high level

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[35] This is also the view of Debelle and Fischer (1994) and Svensson (1997b) who claim accountability is more relevant to central banks with instrument independence rather than goal independence.

of credibility by sustaining low levels of inflation indicating their strong preference for inflation stabilisation, will therefore not require such high levels of accountability.

Similarly, Briault et al (1996) plot their accountability index against the average bond yield for each of the 14 developed countries. They found a slight positive relationship between the two and concluded that increased accountability has, in fact, served as a substitute for credibility. Assuming that bond yields are sufficiently accurate indicators of expected inflation, countries experiencing higher inflation expectations are likely to introduce measures to increase accountability in order to establish credibility. Alternatively, taking into account the lack of relevant observations, this relationship could be interpreted as a lack of success of accountability in reducing expectations in relation to countries that fall in the region of a high average bond yield and a high accountability index.

Nolan and Schaling (1996) attempt to determine whether the absence of accountability necessarily implies that an independent central bank will only act according to its own self-interest. They test their hypothesis by plotting the accountability index constructed by Briault et al (1996) against an alternative measure of central bank independence[36] and find evidence of an inverse relationship, consistent with Briault et al (1996). They conclude that it is more likely that independence will enable a central banker to act according to their own preferences since accountability will be low. Realistically, as noted by Eijffinger and de Haan (1996), this seems unlikely given that any monetary policy which lacks the support of the government, regardless of the degree of central bank independence, will eventually be overridden.

In order to ensure that the credibility benefits of increased central bank accountability are realised, the associated incentive structure imposed on the central bank by the government must be realistic, workable and enforced. Monetary rewards for the achievement of the inflation target in terms of bonus payments to the governor or a larger budget allocation have been suggested. However, the threat of the imposition of penalties where inflation continually overshoots the targeted level is just as important.

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[36] See Eijffinger and Schaling (1993, 1995).

Indeed, Freedman (1993) implied that an incentive structure that does not allow for such penalties may not be as effective particularly for a fully independent central bank. In terms of credibility, it would be in the interests of the central bank to be able to convince the public that it has a considerable amount to lose by not committing to the objective.

As a result, several other alternatives have been offered such as a state-contingent wage contract for the central bank governor. However, such a contract may be difficult to enforce given that payments would fluctuate in accordance with the economy depending on the term of the contract. Further, some discretion would be required on the part of the government to determine the extent to which the governor's wage should be aligned with fluctuations in inflation. Walsh (1993) showed how in some situations where a state-contingent contract would not be practical, a dismissal rule could be implemented. Alternatively, the government may decide that the loss of credibility or more specifically, the 'embarrassment cost' or loss of personal prestige that the central bank governor would suffer in the event of poor inflation out-turns would act as a sufficient penalty. Although such a penalty would be difficult for the government to measure in terms of ensuring its adequacy as a deterrent and it may be the case that the public would seek a more tangible form of punishment to be imposed on the central bank.

Regardless of the incentive structure ultimately instituted, the enforcement of the contract by the government is vital to ensure that the central bank is truly accountable. As already noted, the government will have its own incentives not to enforce the contract. Preferably, it would for the most part be in the interests of the public to ensure that the contract can not be renegotiated without the government incurring a considerable cost since a completely non-renegotiable contract would necessarily translate into full central bank accountability.

Overall, it appears that accountability initially serves as a substitute for credibility following the introduction of a new policy regime. Once the central bank has established a reputation for maintaining low levels of inflation, Faust and Svensson (1997) suggest that accountability causes credibility to become highly sensitive to the

actions of the central bank. Therefore, central banks will have an incentive to avoid full accountability and will instead adopt a more moderate policy response to disturbances.

Similarly, Persson and Tabellini (1993) note that it is surprising that few central banks are actually held accountable for the rate of inflation with the Bundesbank as the most commonly quoted example. Persson and Tabellini (1993) suggest that a lack of accountability for achieving an inflation target is perhaps due to the less observable nature of inflation as opposed to nominal variables such as a money aggregate or the exchange rate. Alternatively, they suggest that it may be that central bankers are reluctant to be held accountable for a variable that they can not directly control.

It may be that the claimed success of contracts as enforcement mechanisms as initially suggested by Walsh (1993) and Persson and Tabellini (1993) is perhaps premature. The ability of such contracts to induce the central bank to co-operate will also depend on the credibility of the target, the stochastic inflation bias and the preferences of the central bank. Since such contracts are typically legislated, it is therefore the government which is ultimately accountable for the effectiveness of monetary policy. While efforts to increase accountability are useful where there is uncertainty regarding central bank preferences, accountability on its own is not sufficient to completely eliminate the inflationary bias.

5.3 Monitoring

The recent trend for central banks to adopt clearer and more concise policy objectives reflects not only an effort to create some degree of accountability, but also to enable the government and the public to monitor the actions of the central bank. As a result, and perhaps for reasons of simplicity, most of the literature has assumed the actions of the central bank to be perfectly monitored. However, central banks may have the incentive to avoid perfect monitoring and instead conduct 'noisy' monetary policy. Typically, monitoring involves a combination of directly observing the behaviour of the targeted variable together with the reporting of the policy responses implemented to control it. With regard to inflation targeting regimes, the central bank's incentive to retain some degree of secrecy will be even more pronounced given that the central bank is unable to directly control inflation. Furthermore, not only are there the obvious measurement

difficulties associated with inflation, but there are also a multitude of economic factors influencing the inflation outcome other than monetary policy which itself is based on imperfect forecasts.

In Canzoneri (1985), while there is no uncertainty regarding the objectives of the central bank, the public can only imperfectly monitor their actions. Canzoneri (1985) assumes that the central bank has private information and adopts 'noisy' policymaking procedures in an attempt to hide their preferences from the public. Since the public are aware of this, they will punish the central bank whenever inflation exceeds their own pre-determined level. As a result, expectations will increase in such inflationary periods regardless of whether the central bank has intentionally allowed inflation to increase or not.

The incentive to conduct noisy monetary policy in order to create uncertainty on the preferences of the central bank is also examined by Cukierman and Meltzer (1986). However, they assume central bank preferences to be endogenous and stochastic. As a result, the public will always be unsure on the stabilisation preferences of the central bank due to the combination of noisy policy and stochastic preferences. So that the public will assume current inflation to contain little informational content and therefore pay no regard to realised values of inflation when forming their expectations. In turn the central bank will be able to create surprise inflation at times when the benefits to output are the greatest.

However, both Canzoneri (1985) and Cukierman and Meltzer (1986) show that ultimately the central bank will suffer as imprecise monetary control results in an increase of both the level and variability of inflation. More recently, there has been some suggestion that despite the resulting inflationary bias, some degree of central bank secrecy can be beneficial. Tabellini (1991) claims that "creating some uncertainty about the 'virtues' of the monetary authorities can be a good substitute for the possibly more difficult task of creating a truly 'virtuous' central bank, at least in the short run" (p197). Similarly, Garfinkel and Oh (1995) conclude from their analysis that the disclosure of noisy policy announcements can even contribute to alleviating the credibility problem.

Garfinkel and Oh (1995) build on Canzoneri (1985) by allowing the public to recognise the possibility that the central bank will disclose noisy announcements and as a result, incorporate this consideration into their expectations. Based on this, it is possible to endogenously determine the equilibrium degree of announcement preciseness. Even though the central bank will always have the incentive to lie, it will be able to retain some degree of secrecy by disclosing noisy, yet truthful, announcements. Garfinkel and Oh (1995) assume that these noisy announcements are concerned with the disclosure of a band in which the central bank's private forecast of money demand disturbances falls within, as opposed to stating the precise value of their forecast.

In the determination of band width, there will be a trade-off between credibility and flexibility in terms of output and employment stabilisation. As a result, Garfinkel and Oh (1995) claim that the central bank may find it optimal to not make any announcements at all even if it is capable of doing so.[37] This is particularly the case for central banks whose credibility problem is so severe that the public will not believe anything they say. Similarly, central banks which are suffering more from a (less than total) lack of credibility than they are from their forecast inaccuracies,[38] will find it preferable to make noisy announcements so as to establish credibility and to also retain some degree of flexibility for output and employment stabilisation.

Even when credibility is established with or without the support of a legislated commitment, Garfinkel and Oh (1995) find that the first-best policy outcome may not occur.[39] As long as the public continued to believe the central bank's forecast then the central bank will want to give the impression that they are in fact following the first-best policy. However, since the public are unable to distinguish between the central bank's forecast and their forecast error, which constitute the money demand disturbance term, it is unlikely that the public will hold such a belief. In which case, inflation will have to be curbed to the detriment of flexibility.

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[37] Cukierman and Meltzer (1986) claim in their analysis that central banks will remain silent so as to retain their ability to generate inflation surprises and subsequent output and employment gains.

[38] Where the central bank's private information (forecasts) are more accurate, then they will be more successful at stabilising inflation and output.

[39] The first-best policy outcome is one which allows efficient stabilisation responses while avoiding any upward inflationary pressure (Garfinkel and Oh 1995, p347).

Of more relevance is the possibility that these noisy announcements are based upon a target rate of inflation rather than on a forecast of money demand disturbances. In this case, Garfinkel and Oh (1995) claim that the specification of such a rule and any associated noisy announcements will always be superior to the discretionary outcome with no communication. However, the credibility problem will remain present to the same extent as in the announced forecast case. None-the-less, Garfinkel and Oh (1995) conclude that such communication significantly improves the appeal of policy rules and to some extent, alleviates the problem of establishing and maintaining credibility.

In the context of optimal contracts, Persson and Tabellini (1993) show how in certain circumstances, retaining a certain degree of central bank secrecy will be preferred. They assume the central bank to possess private information regarding shocks affecting the unexpected component of the inflation rate. While the public are only able to form their expectations on observable shocks to inflation such as a change in the degree of wage indexation. Therefore, this informational asymmetry allows the central bank some degree of flexibility to stabilise output and employment thereby easing the informational requirements of the optimal contract. As noted by Persson and Tabellini (1993) this finding contradicts the current preference for adopting clear rules and transparent policy in an attempt to create accountability and enable monitoring. Indeed, they suggest that the degree to which the central bank seeks to create signal extraction problems depends on both the asymmetry of information and the inclusion of incentive structures in contracts.

Similarly, Walsh (1995) claims that the variety of instruments available to the central bank to implement policy can also exacerbate the signal extraction problem experienced by agents. As an example, The Federal Reserve is able to use reserve requirements, open market operations, the discount rate as well as other instruments to conduct monetary policy. Walsh (1995) claims that it would be virtually impossible for the central bank to be able to anticipate and identify each potential shock that could hit the economy and to select the optimal policy which would offset that specific shock. Furthermore, it would be just as difficult for the central bank to then be able to prove that the announced policy had actually been implemented. Walsh (1995) adds that the informational content of economic and financial market variables is affected by the

operational procedures of the central bank. In particular, the selection of policy instrument will necessarily affect the extent to which policy actions are reflected in key variables.

Specifically, Walsh (1995) adapts his model to show the way in which the central bank will be able to earn economic rents in the event that the implementation of monetary policy is not directly observable by the public. The amount of rent that the central bank will be able to earn by retaining some degree of secrecy will depend on the way in which policy is actually implemented and on the competency of the central bank in terms of its ability to forecast accurately. In order to improve forecasting accuracy, policy implementation and signal quality, various costs will be incurred associated with the necessary increased data collection, staff requirements and financial market monitoring. Walsh (1995) shows that in this case, the combination of higher contract costs and the availability of economic rents will result in the government seeking to minimise both the size of the transfer payment to the central bank (in terms of performance payments or budget allocation) as well as the expected social loss.

The combined effect of measurement problems, inaccurate forecasts, unintentional signal extraction difficulties, random events and a lack of direct control over inflation all imply that the observation of inflation does not necessarily reflect a lack of commitment on the part of the central bank. In fact, Driffill (1987) shows that where there is uncertainty surrounding central bank preferences and where the central bank has imperfect control over inflation, a rise in inflation does not necessarily prove the central bank to be undeniably weak in its commitment to price stability. As a result, the reputation of the central bank will deteriorate but not to zero as most theorists assume. The extent of this deterioration will be smaller the greater the amount of noise present in the system. In the extreme case where none of the players have any control over the outcome, reputation will remain the same regardless of the level of inflation. From this, Driffill (1987) concludes that where the monitoring of the central bank's actions is imperfect, the ability of reputation to effectively substitute as an enforcement mechanism is reduced.

Walsh (1997) claims that it is the degree to which monitoring is imperfect that will determine the level of commitment the central bank will have to fight inflation. At one extreme where the actions of the central bank can be perfectly monitored, Walsh (1997) shows how a strictly inflation-averse central bank will achieve the optimal outcome. At the other extreme with imperfect monitoring, a less strict targeting regime will be more appropriate. In turn, the ability of the government to monitor the central bank will depend on their ability to estimate the central bank's private information. Therefore, when determining the optimal weight to assign to the inflation target, the government will need to balance the costs associated with monitoring the central bank against the desire to remain accountable.

In reality, monitoring usually involves the requirement for central banks to report periodically to the government on its current and proposed stance on monetary policy. In New Zealand, the Reserve Bank is required to publish a statement every six months on its current stance and how it plans to implement policy over the next five years. In Canada, the legislation requires the governor to produce an annual report to the Minister of Finance. In the United Kingdom, following the recent conferment of independence to the Bank of England, further changes to the framework under which monetary policy is governed now require the Bank to report to the Chancellor in the form of an open letter whenever inflation is one percentage point above or below the targeted level of 2.5 percent (The Economist, 1997). Previously, the Bank was only required to publish a quarterly inflation report analysing inflation trends and pressures using a variety of price indexes over the next 18-24 months (Persson and Tabellini, 1994).

While formal efforts to create accountability are more likely to deter the central bank from pursuing objectives that are inconsistent with price stability than the informal incentive of preserving credibility, such efforts on their own are not sufficient to guarantee lower inflation. Increased central bank accountability accompanied by an effective enforcement mechanism may enhance credibility, however there is no guarantee that the inflation bias will be completely eliminated. Further, to assume the actions of the central bank to be perfectly monitored would be an oversimplification. The combination of measurement inaccuracies, the asymmetry of information, imperfect inflation control and the presence of 'noise' (whether intentional or not) all affect the

ability of the government and the public to accurately determine the integrity of the central bank.

Chapter 6

The History of Monetary Policy in New Zealand

Following the period of high inflation during the 1970s and 1980s, the framework governing the formulation and implementation of monetary policy in New Zealand has undergone substantial change over the past decade. As a result, inflation has stabilised at a consistently lower level and policy credibility has been considerably enhanced.

Under the Reserve Bank Act 1964 monetary policy was discretionary and largely determined by the government, specifically the Minister of Finance. Maintaining low inflation was only one of several objectives and due to the influence of government, accordingly received a relatively low weighting. The determination of monetary policy was largely directed towards the pursuit of output and employment growth.

At the same time, the New Zealand economy was heavily regulated and protected. In particular, the prevalence of subsidies, import tariffs and quotas protected domestic producers from external competitive pressures. This in turn contributed to lower productivity and higher import prices. Combined with the oil crisis of the 1970s, inflation began to spiral out of control.

Despite efforts by the Labour government in 1984 to control inflation, the total lack of monetary policy credibility associated with the 1964 Act ensured that inflation expectations were continually anchored at higher levels. Due to the fact expectations determine actual inflation to a large extent, inflation itself also remained above the desired level.

The introduction of the Reserve Bank Act 1989 essentially granted the Reserve Bank independence from the direct intervention of the government in the formulation of monetary policy. More specifically, the Reserve Bank was given the sole objective of price stability as stated in Section 8 of the Act; "the primary function of the Bank is to formulate and implement monetary policy directed to the economic objective of achieving and maintaining stability in the general level of prices." The associated Policy Targets Agreement (PTA) signed by the governor of the Reserve Bank and the

Treasurer[40], details the objective of the Reserve Bank in terms of the specification of a target band for inflation, the specific price index used to calculate inflation, reporting requirements as well as caveats in the event inflation falls outside of the band. Ultimately, it is the government that determines the objectives of the Bank, or more specifically, the band width.

In light of the recent literature on monetary policy it seems that the New Zealand government has taken every possible step to enable the Reserve Bank to establish credibility as a defender of low inflation. These steps include firstly, the abandonment of discretion in favour of a clearly stated policy rule. Secondly, the introduction of a flexible targeting regime in terms of the specification of a band as opposed to an exact target. Thirdly, the conferment of central bank independence from direct government intervention in the formulation of monetary policy. Fourthly, the contracting arrangement of the PTA and the imposition of penalties in the event inflation continually overshoots the target band. And finally, the fact that these institutional changes as well as the associated reporting requirements are legislated ensures that the Reserve Bank is held accountable for its actions.

For the most part, the literature commends the Reserve Bank for its rapid and extensive monetary policy reforms. Ammer and Freeman (1995) refer to the Reserve Bank's price stability objective as 'ambitious', 'elaborate' and most importantly 'credible' (p171). However, it may be useful to analyse in more detail the implications and effects such changes have had to date. While actual and expected inflation has stabilised at lower levels since the introduction of the 1989 Act, it is too early to conclude that full central bank credibility has been achieved. As already shown, it is perhaps impossible to ever prove the existence of, let alone attain, perfect credibility.

In fact, Ammer and Freeman (1995) attribute New Zealand's surprisingly weak economic performance since the introduction of the Reserve Bank Act 1989, to a lack of monetary policy credibility as perceived by the public. They claim that the fact that there has not been a significant reduction in inflation expectations suggests that

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[40] Prior to December 1996, the PTA was signed between the governor of the Reserve Bank and the Minister of Finance.

complete long term credibility has not yet been achieved. Furthermore, they claim that this reflects a lack of credibility in the inflation target. Recall that Johnson (1997) found for the most part, inflation targets were not instantly credible over the 18 countries he sampled. In terms of interpreting the variance of inflation forecast errors as representative of credibility, Johnson (1997) claims that New Zealand produced the third highest variance and was overall unsuccessful at establishing a credible disinflation path.

It appears in New Zealand's case that the costs of reducing inflation have been high with respect to lowering expectations despite the extensive fiscal and monetary reform undertaken over the past decade. Indeed, the Reserve Bank has been criticised by exporters, the agricultural sector, trade unions and the public for stifling growth and employment. In order to reduce expectations and shift preferences to some extent, the Reserve Bank has taken various measures to convince the public on the benefits of maintaining price stability.[41] Specifically, the Bank has asserted that price stability is essential in order to attain long term economic growth and that the benefits of allowing higher inflation are only short-lived if they eventuate at all.

In New Zealand, expectations appear to be largely driven by recent inflation lending some support to the adaptive expectations hypothesis (McCallum, 1989). Therefore it would seem that expectations will decline following a reduction in actual inflation. This will obviously depend on the particular survey used to approximate expectations. Typically, households and labour unions hold consistently higher expectations than the financial and business sectors. Despite the great deal of uncertainty regarding the behaviour of expectations, McCallum (1989) adds that it is vital that the implications and effects of monetary policy on prices and costs are made very clear, if expectations are to be lowered.

Recent changes made to the PTA regarding the target may have an effect on expectations and therefore on credibility. In December 1996 following the formation of

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[41] Such measures include the various public speeches given by the governor to interest groups, education kits for secondary schools and the publication of a series of pamphlets explaining the impact of monetary policy on exporters, farming and people.

the National-New Zealand First coalition, the target band for inflation was increased from 0-2% to 0-3%. Secondly, the sole objective of price stability was altered somewhat, allowing the Reserve Bank to give some consideration to output and employment when formulating monetary policy. Specifically, it instructs the Reserve Bank to ensure that ".... monetary policy can make its maximum contribution to sustainable economic growth, employment and development opportunities within the New Zealand economy."

These amendments reflect the fact that the Reserve Bank is by no means truly independent from the influence of the government. It has been generally accepted that the Reserve Bank has been granted instrument independence but relatively less goal independence. In fact, it is due to this co-operation between the Reserve Bank and the government in the determination of monetary policy objectives, that Pollard (1993) considers the Reserve Bank to be theoretically dependent. It may be that the conferment of instrument independence on its own is sufficient to eliminate the type of political business cycles evident in New Zealand's money growth rate prior to 1989.

Associated with instrument independence is instrument credibility. While the Reserve Bank operates monetary policy through the alteration of the settlement cash target imposed on registered banks, changes to this target are infrequent. Instead, the release of press statements by the Reserve Bank are usually considered sufficient to alter interest rates in the desired direction. However, there are obvious problems associated with this method of policy implementation in terms of obtaining the desired magnitude of interest rate response as well as monitoring difficulties on the part of the government. In fact, it is questionable whether such a method meets the requirement of being "sustainable, consistent and transparent" as set out in Section 4(c) of the PTA.

McCallum (1995) considers the Reserve Bank's indirect implementation of monetary policy to be largely effective in terms of avoiding policy delays. He claims that central banks that have the ability to directly control short-term interest rates may delay policy due to the highly observable and politically sensitive nature of interest rates. Furthermore, while there is some doubt over the effectiveness of the transmission mechanism from a change in the settlement cash target to inflation and other variables,

the cash target is obviously closely related to the money supply and has the added advantage of not being so politically sensitive.

Never-the-less it would seem that the government is certainly exerting as much of an influence as it is capable. While it is still too early to determine the effects of increasing the band width by one percentage point, the requirement that the Reserve Bank consider output and employment when formulating monetary policy is quite significant.[42] This tends to suggest that output should also be included in the Bank's reaction function and that some weighting should be assigned between it and inflation. Therefore, in terms of Rogoff (1985), the Reserve Bank is not strictly conservative.

As noted by Svensson (1997a), conservatism is neither realistic nor desirable due to the resulting variability of exchange rates, interest rates, employment and output that are usually associated with over-zealous policy responses to bring inflation back to target as quickly as possible. However, it is important to recognise that a strictly inflation-averse monetary policy will only lead to an increase in the variability of these variables and not necessarily their levels. It is when monetary policy is used to achieve permanent increases in employment and output, that significant problems are caused.

The extent to which the Bank will consider growth in its formulation of monetary policy will obviously impact expectations. Specifically, a tightening in monetary policy in response to inflationary pressures may be delayed if the sustainability of economic growth is under threat. The effect that this amendment to the PTA will have on the credibility of the Reserve Bank to maintain low levels of inflation will be difficult to determine.

Persson and Tabellini (1993) consider New Zealand's PTA to be almost representative of the performance contracts they analyse. The incentive structure of the monetary policy reform involves the threat of dismissal of the governor in the event inflation is

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[42] There was mixed reaction on the increase in band width from 2% to 3%. Turner (1996) concludes that the latter is the minimum feasible band width New Zealand should consider. While Svensson (1997c) sees no reason for such an increase as there is no evidence suggesting poorer economic performance at a target of 1% as opposed to 1.5%.

continually outside of the target band.[43] Additionally, seigniorage revenues may not exceed a pre-determined level and the Reserve Bank's budget allocation is fixed for a period of five years.

In terms of accountability, the Reserve Bank is required to publish a Monetary Policy Statement every six months. In terms of the PTA, a statement requires the Bank to be fully accountable for its actions but does not specify explicitly how this is achieved. In terms of the index constructed by Briault et al (1996), the Bank is not considered fully accountable solely because the minutes of monetary policy formulation meetings are not published. However, the publication of the Monetary Policy Statement, the provision of caveats in the event the target is not achieved and monitoring by the government place New Zealand as the second most accountable central bank in the 14 countries analysed.

The most recent change to the PTA in December 1997 reflects an attempt to further enhance the accountability of the Reserve Bank. There had been some concern over the fact that the official measure of inflation depended on the determination of underlying inflation as calculated by the Reserve Bank. The revised PTA dictates that the target will be defined according to the CPI excluding credit services as published by Statistics New Zealand. The fact that the official measure of inflation is now more observable will also ease the monitoring problem experienced by the government and the public.

While inflation expectations have become consistently lower in recent years, it is perhaps too early to search for evidence of credibility. The establishment of long term credibility will not only depend on the future behaviour of inflation and the actions of the Reserve Bank, but also on any proposed institutional developments that affect the conduct of monetary policy.

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[43] As part of the monetary policy reform prior to the introduction of the Reserve Bank Act 1989, the government considered providing for monetary rewards to the governor in the event that the inflation target was achieved. However, it was decided that the threat of dismissal was a sufficient incentive to ensure the central bank complied with the policy objectives as specified in the Act.

Chapter 7

An Overview of the Reserve Bank's Macroeconomic Model

The models used in the literature to analyse central bank credibility are often criticised for being too simple. In particular, Driffill (1988) notes that the fact these models are largely static and deterministic in nature and consider only a few macroeconomic variables, acts as a severe limitation. Not only will the theoretical conclusions derived from such simple models be questionable, empirically it would be almost impossible to obtain sensible results on the effects of central bank behaviour and credibility. Given the unobservable nature of credibility, attempting to incorporate various aspects of uncertainty would prove even more difficult.

Rather than empirically analyse the implications of credibility it is perhaps preferable to abstract from reality given the difficulty involved in measuring credibility combined with the lack of relevant post-reform observations. The Reserve Bank's model used for forecasting and policy analysis (FPS) provides a sufficiently dynamic and rich economic structure to provide some insight into the effects of central bank behaviour in response to various shocks in the light of uncertain credibility. While a Reserve Bank Research Paper provides a more in depth description of the features of FPS, a brief overview of the model will be provided here.[44]

In terms of forecasting, FPS provides a general indication of the path of a multitude of macroeconomic and microeconomic variables over the medium to long term derived from the historic behaviour of these variables together with their short-term forecasts and judgement. Additionally, FPS can be used for policy analysis. This may involve an examination of the implications of specific shocks or changes in equilibrium and the effects of alternative policy responses.

FPS is calibrated as a system consisting of approximately 155 behavioural equations and identities. Calibration has been preferred over the individual estimation of each equation due to the fact that the latter usually results in overfitting causing the equation

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[44] See Black et al (1997).

to break down out-of-sample. Combined with the problems typically associated with economic data in terms of measurement, time span and presence of structural breaks, calibration according to established economic relationships is perhaps more useful.

The steady-state version of FPS is an equilibrium model representing the steady state to which the dynamic model version converges. It allows for the extensive interrelationship between agents within a small open economy in terms of stock-flow accounting. Relative prices adjust to ensure that income and expenditure flows adjust to achieve and maintain desired stocks of wealth and debt. The household sector is modelled using an overlapping-generations framework with utility-maximising consumers falling into one of two categories. 'Rule-of-thumb' consumers spend all of their income each period and hold no assets while 'forward-looking' consumers save on average and accumulate assets as a result.

The profit-maximising behaviour of firms is modelled in FPS by way of a representative firm which produces goods, pays wages and purchases capital. In terms of the latter, the firm incurs adjustment costs over and above the initial investment outlay resulting in a gradual adjustment of the capital stock. Furthermore, time-to-build constraints are incorporated on the assumption that the effects on production resulting from the purchase of capital will occur some time in the future.

Rather than face a maximisation objective, the government faces a budget constraint subject to the setting of paths for debt and expenditure. More specifically, the long-run path for debt, transfer payments, expenditure, the capital tax rate and the indirect tax rates are all set exogenously. The labour income tax rate is then determined to achieve the desired debt ratio.

Given that FPS models a small open economy, the behaviour of domestic agents has no affect on that of foreign agents whose actions are assumed exogenous. The net foreign asset position is determined by the level of government debt, the firms' equilibrium level of capital stock and the households' desired level of assets. In turn, the level of net foreign assets determines the trade balance so that the current account will consist of the trade balance together with interest payments on net foreign assets.

In terms of the labour market, the supply of labour is exogenous and in time determines the equilibrium real wage according to the usual marginal product of labour condition. Nominal wages are largely driven by the behaviour of the business cycle but experience downward rigidity. Additionally, the staggering of wage contracts also allows for some degree of inertia in the bargaining process.

Growth is modelled in FPS according to the neo-classical growth model, consistent with Cobb-Douglas production technology and a balanced growth equilibrium. The overall trend of growth in FPS is set exogenously with paths pre-specified for both productivity and population growth. The trend productivity growth component represents technical progress in terms of efficiency units of labour as opposed to total factor productivity. Instead, total factor productivity is incorporated into the production function representing technological progress. However, the capital-to-labour ratio with respect to productivity growth is not constant so that the benefits resulting from developments in technological progress materialise in the form of an increase in the real wage.

Both the fiscal and monetary policy reaction functions are endogenous in FPS. With regard to the former, the government is pre-committed to achieve long run targets and therefore can not select a policy response inconsistent with this path. Similarly, due to the largely forward-looking specification of the monetary policy reaction function, the central bank seeks to determine the optimal response to achieve the targeted level of inflation. FPS assumes the central bank adjusts the short-term nominal interest rate whenever expected inflation deviates from its target accordingly:

$$rs_t - rl_t = rs_t^* - rl_t^* + \sum_{i=1}^{j} \theta_i (\pi_{t+i}^e - \pi_{t+i}^T)$$

where rs and rl represent short term and long term nominal interest rates respectively, and an asterisk denotes their equilibrium values, π^e represents expected inflation and π^T targeted inflation with j leads and associated weights (θ). It is assumed that the 10-year interest rate (rl) is consistent with the expectations theory of interest rate term structure and therefore represents the expected short term rate plus a constant risk premium. Although the monetary authority implements policy via the short term nominal interest

rate, the reaction function is expressed in terms of the slope of the yield curve in order illustrate the effects of both policy actions and inflation expectations on the behaviour of inflation.

The real exchange rate responds to movements in real interest rates following changes to the nominal rates. The response of the exchange rate to such movements is only gradual due to the allocation of weights on the lagged exchange rate. The real exchange rate will also change according to movements in its equilibrium value, the world interest rate and the domestic risk premium. The equilibrium value is derived from the trade flows required to maintain the equilibrium net foreign asset position. Expectations of the real exchange rate adjust slowly due to the allocation of weights between lags and leads of the actual real rate. From the real exchange rate, it is possible to derive its corresponding nominal rate using the domestic-foreign price ratio.

Prices are all defined to be relative in FPS with the price of domestically produced and consumed goods serving as the numeraire. Therefore there will be a separate relative price for consumption goods, investment goods and government goods with a further split into their respective domestic and imported components. A less than strict purchasing-power-parity condition is imposed in order to consider the influence of foreign prices on domestic prices while allowing for transport and distribution costs.

Inflation can result from several sources in FPS. These include foreign inflationary pressures, shocks to aggregate demand and supply, input prices, nominal wages, indirect tax rates and the inflation expectations of agents. The incorporation of an asymmetric Phillips curve formalises the inflation process. It is assumed that there is some degree of inertia present in inflation in order to account for the commonly observed link between past and current inflation. Expectations are partially backward-looking and partially forward-looking to provide some degree of realism. The natural rate hypothesis is assumed to hold reflecting the lack of a permanent trade-off between inflation and output. Specifically, when output is at potential and employment at its natural rate then expectations will be equal to the inflation rate, in this case the inflation target. Furthermore, when the output gap is positive an extra term is added to the

Phillips curve to account for the fact that excess demand is more inflationary than excess supply is deflationary.

It is the specification of the Phillips curve and the formation of expectations that are of particular relevance for the purposes of this analysis into the effects of credibility. Changes to the weighting assigned to the inflation target component of expected inflation is assumed to reflect changes in credibility. Intuitively, a lower weighting on the inflation target and a corresponding higher weight assigned to the backward-looking component reflects less central bank credibility. A more detailed description of the methodology used to conduct the simulations of FPS will be provided in the following two chapters.

Chapter 8

A Preliminary Analysis of Credibility

Initially, the model was simulated to analyse central bank behaviour under conditions of uncertain credibility subject to one particular shock. Uncertainty is incorporated in terms of the lack of information that the bank has on both its level of actual credibility and the future path of each temporary shock. The impulses analysed include aggregate demand, foreign demand, domestic prices, the exchange rate and the domestic terms of trade. The shocks that appear in the FPS equations are derived from the impulse responses to a six variable VAR model, a brief explanation of which is provided at the end of the following section.[45] The motivation for examining the effects of each individual impulse reflects an attempt to provide some degree of intuition to interpret the results derived from the stochastic simulations.

8.1 Methodology

A comparison is made between four possible credibility worlds for each of the five individual impulses. The first world represents the case where the central bank responds believing it has credibility when in fact it does (CC). The second and third worlds represent the situation in which the central bank makes a policy error. The former considers the effects where the bank believes it has credibility when it does not (CN) and the latter considers the case where it believes it has no credibility when it actually does (NC). Finally, the fourth world represents the bank believing it has no credibility and it accordingly does not (NN).

Once the specific unanticipated shock has hit the economy, the central bank sets policy in that period taking into account the level of credibility it assumes it has. The ability of the implemented policy to bring inflation back to target depends upon the actual level of credibility as determined by the public.

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[45] The technology to derive such shocks to perform stochastic simulations with FPS is relatively new at the Reserve Bank. A detailed description of the generation of stochastic simulations and the derivation of the five shocks is appendixed in Conway et al (1998).

In order to perform this experiment, four versions of FPS are used. In the CC world, once an impulse hits the economy the central bank responds believing it has credibility. Specifically, it assumes that the public form their expectations of inflation assigning a weight of 0.2 on the central bank's target. In this version of FPS, the reaction function is activated and it should be interpreted as the central bank's forecasting model. The policy response is then fed through into the second version of FPS which represents the 'real world'. Since in the CC world the bank does in fact have credibility, expectations are formed according to a 0.2 weighting on the inflation target consistent with the central bank's forecasting model. In this real world model, the reaction function is de-activated as policy has already been determined in the bank's forecasting model. In every other respect, both versions of FPS are the same. The only possible model-related error the central bank can make when formulating policy is to assume the wrong level of credibility. Once the results of this policy action have been realised in the real world, time is up-dated one quarter and the monetary authority generates another forecast based on this period's shock and the previous period's outcomes. They can then take further policy action depending on these effects. This loop continues for the entire simulation period until all variables have converged to their initial steady-state values.

For the CN world two versions of FPS are also used. Policy is set exogenously in the real world model according to the solution from the bank's forecasting model as before. The difference here is that while the bank's forecasting model will have set policy assuming agents place a weighting of 0.2 on the expected inflation target, the actual model has a weighting of zero on the expected target which will obviously affect the success of the implemented policy. Similarly, in the NC world there is a weight of zero on the inflation target in the bank's forecasting model and 0.2 in the real world model. In NN there is no weight on the target in inflation expectations in either the forecasting model or in the real world.

It is important to note that changes to the coefficient on the inflation target in inflation expectations correspondingly affect the backward-looking component of inflation only as shown:

$$\pi_t^e = (1 - F - C)\sum_{j=1}^{j}\alpha_j\pi_{t-j} + F\sum_{j=1}^{j}\beta_j\pi_{t+j} + C\pi^T$$

where π^e represents expected inflation, π measures actual inflation with j lags or leads, π^T is the inflation target, α is the coefficient on lagged inflation and β is the coefficient on forward inflation. In their formation of expectations, agents assign a weight (F) on forward inflation and a weight (C) on the target. An increase in credibility (C) will result in a corresponding decrease on the weighting on the backward-looking component (1-F-C). Throughout the whole analysis, the weighting on the forward-looking component (F) summing over eight quarters remains equal to 0.1, so that the weighting on the backward-looking component summing over four quarters will equal either 0.9 or 0.7 depending on credibility (C).

The path for each shock has been pre-determined and is based on the historic behaviour of key macroeconomic variables in New Zealand over the past 12 years. As detailed in Conway et al (1998), to perform stochastic simulations with FPS requires determining the shocks necessary to get FPS to recreate the same behavioural responses as those generated by a one standard deviation impulse in the VAR. Specifically, in Conway et al (1998) a VAR of the New Zealand economy was estimated over the period from 1985q2 to 1997q2. The VAR consisted of six variables namely aggregate demand (consumption and investment), foreign demand, the price level (CPI), the real exchange rate, the terms of trade and the slope of the yield curve.

The impulse responses of five of the six potential impulses from the VAR are used to calculate the shocks necessary to get FPS to replicate the behaviour of the VAR. The VAR impulse response functions appear in the Appendix. Included in the behavioural equations of the respective variables in FPS are associated shock terms. Given the behaviour of the variables as determined by the VAR following a specific impulse, FPS is simulated to solve for the respective variables' shock terms for four quarters. These shock terms can then be used to get FPS to produce the same response of the variables as the paths generated by the one standard deviation impulse in the VAR.

For the purposes of this analysis, five out of the six impulses are used. The impulse response to the policy instrument is not used. Nor is a shock term on the path for the policy instrument calculated in order to replicate the VAR path in the remaining five impulses. Specifically, the aggregate demand component of the impulses is transmitted through the shock term on consumption by forward-looking consumers. The foreign demand component is picked up by the export shock term. The price component is picked up by the shock term on the inflation rate for the price of domestically produced and consumed goods at factor cost. The exchange rate component is embodied in the real trade-weighted exchange rate shock term, while the terms of trade component is picked up by both the relative export price shock term and the shock term on the relative price of imported consumption goods.

## 8.2 Results

8.2.1 Aggregate Demand Impulse

Figure 8.1 illustrates the dynamic behaviour of several key macroeconomic variables to the positive impulse to aggregate demand for each of the four worlds. The worst outcome occurs when the central bank responds to the inflationary pressure on the assumption it has credibility when it in fact doesn't (CN).

In this case, since the bank assumes they have credibility, only a relatively loose policy is implemented (indicated by a relatively small increase in the slope of the yield curve), as the bank believes that expectations will help re-anchor inflation at the target. Even though the excess demand has been eliminated in all four worlds by the ninth quarter, inflation in the CN world deviates for a further seven quarters. Due to the asymmetry of the Phillips curve, excess demand generates more inflation than the deflation generated by the same amount of excess supply. Thus, the weaker the policy response, the more excess demand is allowed to build up and so the greater the cost in terms of the output loss required to anchor expectations. This is illustrated by the cumulative output gap. Therefore, expectations in the CN case will be consistently higher and will only gradually adjust compared with the other three worlds. This arises not only due to the lack of actual credibility, but also due to the mistaken assumption of credibility by the central bank.

Figure 8.1

Positive Aggregate Demand Impulse

CC - Solid;   CN - Dotted;   NC - Dashed;   NN - Dash-dot
Percentage Point Differences (shock minus control)
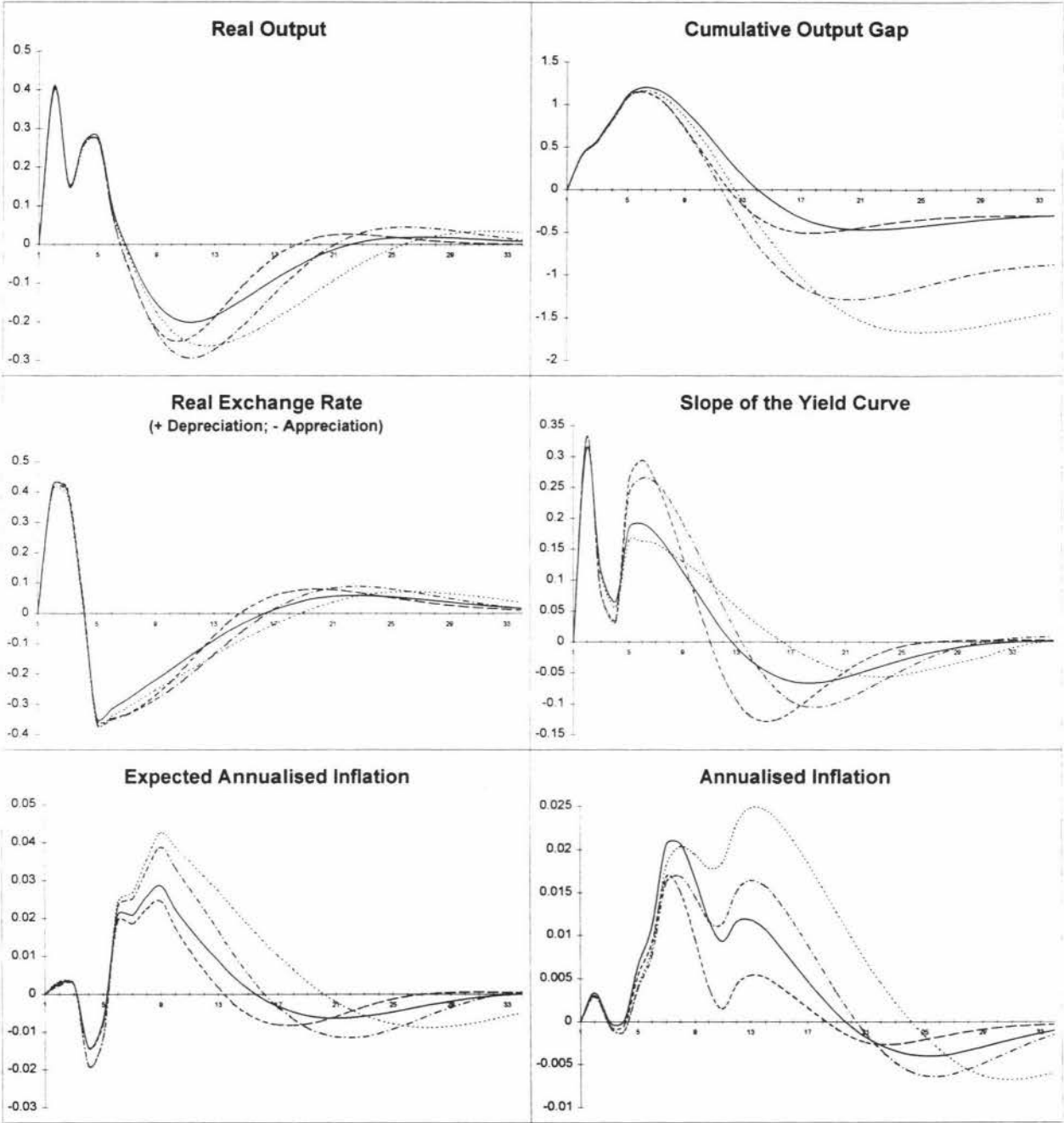
In comparison with the NN case, it is obvious that policy errors are costly. Due to the fact that the central bank is correct in its assumption on its lack of credibility in the NN world, output losses will accrue but to a smaller extent than in the CN case. Since the bank assumes its has no credibility it will tighten policy relatively more than if it believed it had. As a result, inflation is brought down more quickly and with less variability than the CN world.

It is interesting to note that the costs will be greater to the central bank when it makes a mistake on its credibility assumption in a non-credible world. In the event that the central bank is truly credible, it seems almost irrelevant what the bank assumes. While output losses will be minimised in the CC case, compared with the output loss associated with NC the difference is negligible. However, in the latter world the bank will increase interest rates sharply as it assumes expectations are sluggish. Instead, expectations adjust quickly and disinflation is comparatively rapid so that the target is achieved in the shortest period of time.

8.2.2 Foreign Demand Impulse

Figure 8.2 represents the effects of a positive foreign demand impulse. Here, it is also evident that the assumptions made on credibility by the central bank have little effect in determining the outcomes in a credible world.

Due to the fact that there are two channels through which foreign demand can affect domestic inflation, excess demand continues to accumulate over several more quarters than the domestic demand shock. Specifically, an increase in foreign demand will increase exports and therefore domestic production, creating inflation. Similarly, the improvement in the domestic terms of trade serves to exacerbate the domestic inflationary pressures even further. Since the central bank does not anticipate the shock, the delay in implementing policy allows more excess demand to build up.

Initially, the effects on domestic demand are relatively small since it is the increase in world prices that has the immediate impact on the domestic economy, so that the bank responds by increasing interest rates only to a small extent. The improvement in the current account reflecting the favourable terms of trade will lead to higher consumption

Figure 8.2

Positive Foreign Demand Impulse

CC - Solid; CN - Dotted; NC - Dashed; NN - Dash-dot
Percentage Point Differences (shock minus control)
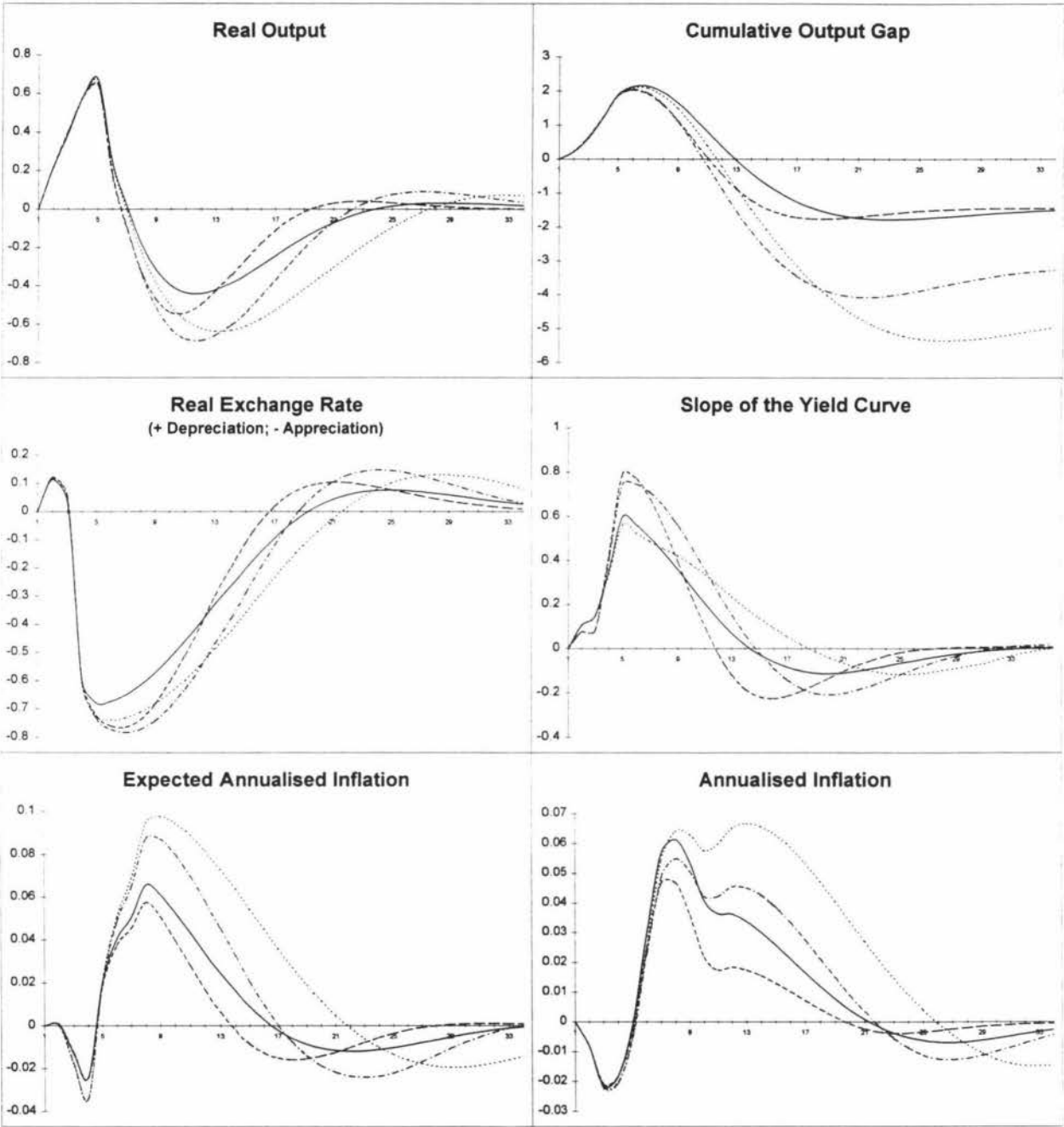
as households use their excess foreign assets to finance a temporary consumption boom. Combined with the increase in foreign demand, excess demand accumulates and accordingly inflation accelerates.

Similar to the aggregate demand impulse, a central bank that assumes it has no credibility will raise interest rates to a larger extent since they anticipate expectations to be more difficult to return to target. In each case, the bank raises interest rates sharply in order to eliminate the excess demand and only slowly eases policy due to the fact there will be time lags involved in adjustments to production levels by firms. Compared with the aggregate demand impulse, inflation and expectations will be brought back to target at a slower rate. As expected, this rate will be more gradual for the world where the bank mistakenly assumes it has credibility (CN). Similarly, where the bank has credibility, the path of inflation back to target will be consistently lower.

A brief period of deflation occurs prior to convergence generated by the excess supply required to bring inflation back to target. Some of this excess supply represents the adjustment by households to restore their desired holdings of net foreign assets. Again, in terms of losses to output, it is relatively irrelevant whether the bank makes an error in a credible world (CC, NC). A less credible bank will suffer to a considerable extent if it mistakenly assumes it has credibility (CN).

Compared with the domestic demand impulse, the foreign demand impulse exacerbates the inflationary pressure due to the effect of the terms of trade component absent in the former. This reflects the historic behaviour of the New Zealand economy and the dominant effects of foreign shocks on the domestic economy as indicated by the VAR. Therefore, assumptions on credibility will be even more sensitive to adverse effects for a non-credible central bank in the event of a foreign demand shock to the New Zealand economy.
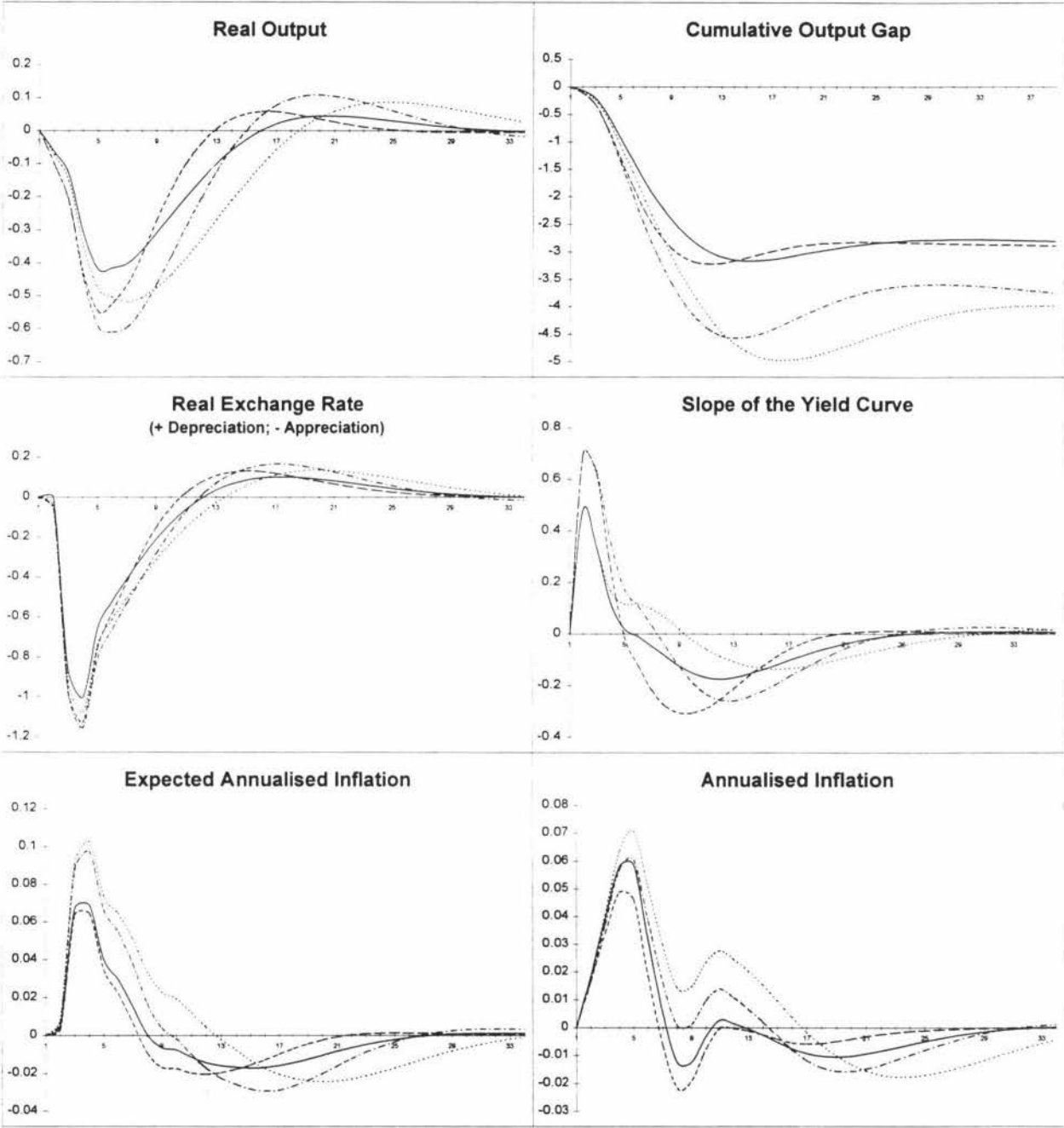
8.2.3 Price Impulse

The effects of a positive impulse to the price level are shown in Figure 8.3. Consistent with the results from the demand impulses, inflation is easier to control when the central bank has more credibility. However, it is interesting to note that while there remains a

Figure 8.3

Positive Price Impulse

CC - Solid;   CN - Dotted;   NC - Dashed;   NN - Dash-dot
Percentage Point Differences (shock minus control)

substantial difference between the output losses of a truly credible and non-credible bank, it appears that under a price impulse the cost of making an error is relatively smaller than under demand impulses.

This is due to the non-linearity of the Phillips curve. Policy actions are required to ensure sufficient excess supply is generated to re-anchor inflation to the target. When policy initially responds too mildly due to the mistaken perception of credibility, the required excess supply simply gets generated later once the central bank realises inflation is still above its forecast. Under the price impulse, the central bank is operating on the linear part of the Phillips curve and policy errors have no cost in terms of the cumulative excess supply required to re-anchor inflation.

As expected, when the central bank assumes it has credibility, interest rates will be raised to a slightly smaller extent. Due to the relatively lower level of persistence of the price impulse, policy returns to control faster than under both the domestic or foreign demand impulses. However, following a price impulse, the central bank responds fairly quickly due to the rapid acceleration of inflation. The exchange rate appreciates making imports cheaper relative to exports and so imports increase. Combined with the eventual easing of policy, the resulting increase in consumption raises output above potential creating a small amount of excess demand. In turn, there is a secondary cycle in inflation which is only weakly conveyed in expectations a few quarters later. While the ranking according to inflation performance remains identical to the results obtained from the demand impulses, there is relatively less drift in CN and deviation between it and NN which explains the similarity in output loss.

This is a direct effect of the asymmetry of the Phillips curve. Since the initial effect is an accumulation of excess supply, only the linear part of the Phillips curve will have an impact. For the non-credible central banks, inflation will remain above target longer and therefore they will continue to allow output to decrease to a larger extent. Where the Phillips curve is linear, policy errors will have little effect on the ultimate outcome. Realistically, this is not the case as typically banks are required to respond more strongly to inflationary than deflationary pressures highlighting the fact that policy

errors surrounding assumptions on credibility do in fact matter a great deal for a strictly non-credible bank.

8.2.4 Exchange Rate Impulse

The effects of an exchange rate impulse are shown in Figure 8.4. In terms of the rankings of the four worlds, the results are basically identical to the domestic demand impulse. However, under the exchange rate impulse, the adverse effects in terms of magnitudes from making policy errors are considerably larger.

Following the depreciation, the resulting excess demand increases inflation sharply. The central bank responds in each case by raising interest rates. The resulting exchange rate appreciation and investment dampening both serve to eliminate the excess demand. The appreciation reduces both foreign demand for exports and domestic demand for imports. The inflation rate begins to decline for all four worlds for approximately a year when CN experiences another cycle and only gradually declines. As a result, a significantly larger amount of excess supply is required to bring inflation back to target and the cumulative output loss in the CN world is quite substantial in absolute terms.

Policy errors are therefore costly under such an exchange rate impulse. Deviations of inflation from target are considerably more variable and output losses more substantial compared with the domestic demand impulse. Again, this reflects the small open nature of New Zealand's economy and the subsequent vulnerability of central bank credibility to foreign influences.

8.2.5 Terms of Trade Impulse

The effects from a positive terms of trade impulse are shown in Figure 8.5. Here, a similar result to the price impulse is obtained in terms of the irrelevance of central bank assumptions on credibility. This is due to the prevalence of excess supply effects over excess demand. The initial excess demand is short-lived as the appreciation of the exchange rate eventually dampens demand and generates excess supply. Further, the deflationary effect from lower import prices starts to affect inflation as well. The central bank eases policy in an attempt to raise inflation back to target. As expected, the central

Figure 8.4

Real Exchange Rate Deprecation

CC - Solid;   CN - Dotted;   NC - Dashed;   NN - Dash-dot
Percentage Point Differences (shock minus control)

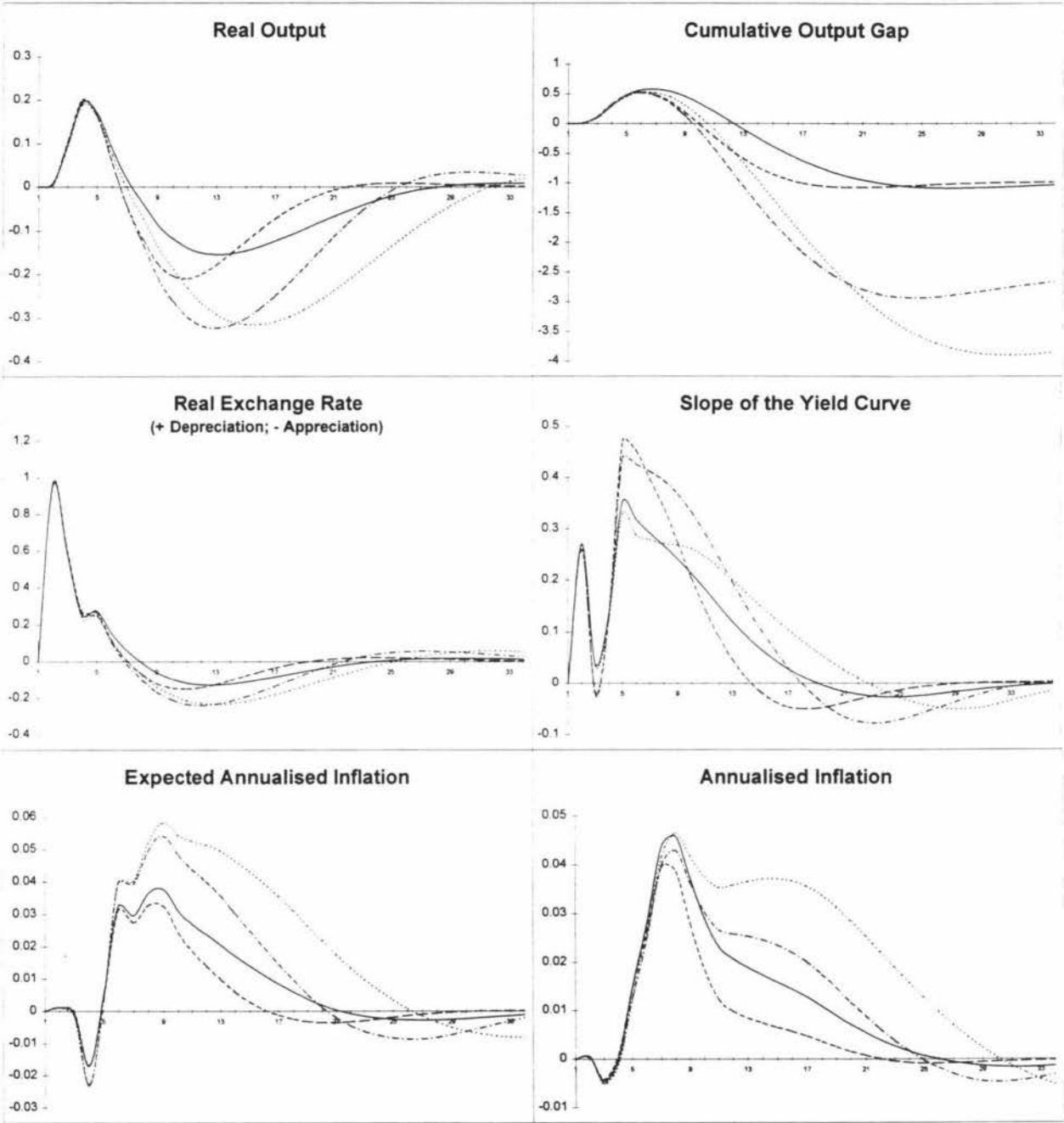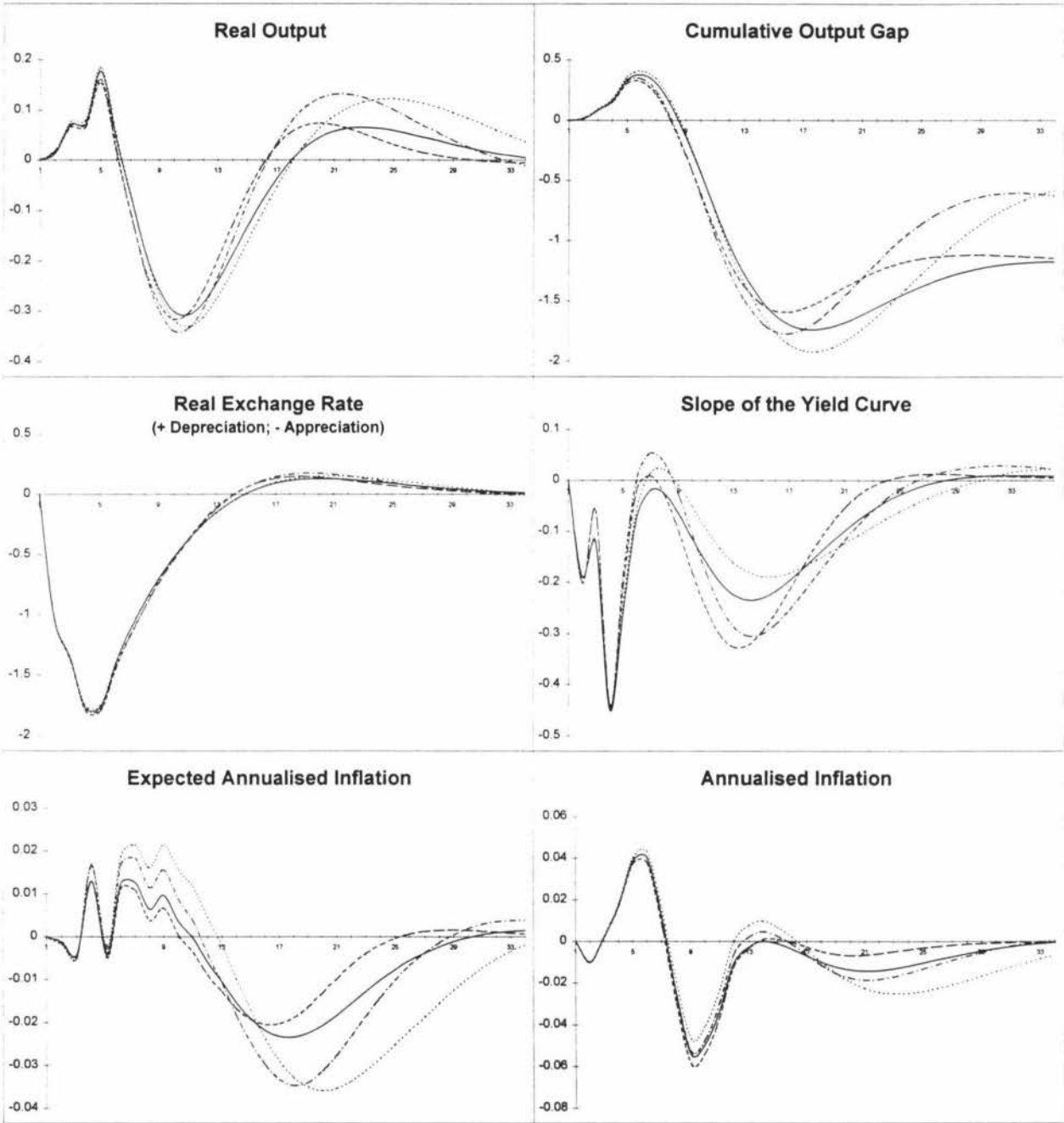# Figure 8.5

Positive Terms of Trade Impulse

CC - Solid;   CN - Dotted;   NC - Dashed;   NN - Dash-dot
Percentage Point Differences (shock minus control)

Real Output

Cumulative Output Gap

Real Exchange Rate
(+ Depreciation; - Appreciation)

Slope of the Yield Curve

Expected Annualised Inflation

Annualised Inflation

banks which assume credibility (CC, CN) ease policy to a smaller extent since they believe expectations will return to target at a faster rate. Accordingly, such a weak response allows more excess supply to accumulate. However, the truly credible central banks (CC, NC) need to create a smaller amount of excess demand as deflationary pressures are short-lived in these two worlds. While the non-credible banks need to generate a larger amount of excess demand and a lower overall cumulative output loss results. Specifically, in the event that a non-credible bank mistakenly assumes it has credibility (CN) the excess demand will be sustained for a longer period of time, effectively offsetting a substantial amount of the previous output loss.

Therefore, not only are policy errors irrelevant under a favourable terms of trade impulse but it would seem preferable for the central bank not to be credible in terms of alleviating the overall output loss. Under deflationary shocks, a credible central bank will need to generate less excess demand. Therefore, the credible central banks will accumulate a larger amount of excess supply than the non-credible banks.

An improved understanding of the framework under which stochastic simulations operate is achieved by the above analysis on the effects of each of the five individual impulses. While it would seem policy errors are irrelevant under deflationary shocks, empirical evidence tends to suggest that the world is in fact non-linear and that on balance inflationary shocks are predominant. Therefore overall, a credible central bank will not be significantly affected by the weighting it believes agents have assigned to the target in their inflation expectations. While a non-credible bank will be better off knowing the truth and accordingly implement policy in a prudent manner by assuming it has no credibility. This prudent approach to monetary policy will be even more crucial in response to shocks emanating from foreign disturbances given the small open nature of the New Zealand economy.

Chapter 9

A Stochastic Analysis of Credibility

While the single impulses are useful in providing some intuition about the implications of central bank credibility, realistically disturbances are more likely to affect the economy in a more complex manner. At any point in time, several of these impulses will be hitting the economy simultaneously in conjunction with the persistent effects of impulses occurring in previous periods. In order to incorporate this more realistic policy environment, stochastic simulations of FPS are used and the resulting root mean squared deviations (RMSD) and mean deviations calculated.

9.1 Methodology

As in the previous experiment, four versions of FPS have been used with the same policy feedback loop enabling the central bank to continually update monetary policy according to both their observation of the impulse hitting the economy in the current period and the outcome from the previous period. The only difference here is that rather than looking at only one impulse, all five are randomly drawn. The random independent and identically distributed (iid) random variables used to generate the specific shocks in FPS are drawn from a standard normal distribution. One iid variable is drawn for each impulse each period. For example, a random iid variable for the foreign demand impulse is drawn to be 1, then a one standard deviation foreign demand impulse hits the domestic economy.

Once determined, these shocks are set exogenously and FPS is simulated in order to solve for the variables' behavioural response. One vector of impulses which determines the corresponding vector of shock terms is considered to be one iteration. The model is simulated for 100 iterations with each iteration using a random impulse vector as drawn from the normal distribution. Each set of 100 iterations constitutes one "draw". For the purposes of this analysis, FPS was simulated over 100 quarters for 100 draws and summary statistics calculated.

There are two specific summary statistics of interest. Firstly, the RMSD of each variable from its deterministic equilibrium value has been calculated and averaged across draws. This provides some indication on the relative variability of the four key macroeconomic variables of interest (inflation, output, the policy instrument and the exchange rate) in each of the four worlds. Secondly, the mean deviation of each of the four variables from their deterministic steady state values provides additional information.

Given that the impulses have been derived from the historic behaviour of key macroeconomic variables in New Zealand over the past decade, on balance the stochastic simulation of FPS should embody the relative importance of each of the impulses. The resulting moments should effectively summarise the net impact of the implications highlighted in the analysis of the individual impulses.

9.2 Results

The RMSDs of the four key variables are presented in Table 9.1 and the mean deviations in Table 9.2. It is perhaps useful to initially discuss the implications of a credibility misperception for a truly non-credible central bank (CN versus NN) and subsequently the implications for a truly credible central bank (NC versus CC).

Table 9.1

Root Mean Squared Deviations

Variable	CB assumes it has Credibility		CB assumes it has No Credibility	
	CB is Truly Credible (CC)	CB is Truly Non-credible (CN)	CB is Truly Credible (NC)	CB is Truly Non-credible (NN)
Inflation	0.87	1.16	0.73	0.91
Output	1.93	2.45	2.02	2.46
Instrument	1.77	1.76	2.31	2.37
Exchange Rate	4.61	4.74	4.80	4.88

Table 9.2

Mean Deviations from Equilibrium

Variable*	CB assumes it has Credibility		CB assumes it has No Credibility	
	CB is Truly Credible (CC)	CB is Truly Non-credible (CN)	CB is Truly Credible (NC)	CB is Truly Non-credible (NN)
Inflation	0.048	0.60	-0.068	-0.004
Output	-0.38	-0.53	-0.41	-0.53
Instrument	0.68	0.72	0.52	0.84
Exchange Rate	-0.13	-0.18	-0.11	-0.18

* The mean deviations of the inflation rate, the policy instrument and the exchange rate are in terms of percentage points above their respective long-run equilibrium values. The long-run equilibrium value for the inflation rate is the mid-point of the target band (1.5%). The mean deviation of output is the percent deviation from potential. Recall that a negative exchange rate reflects an appreciation.

The main result as indicated by the RMSDs, is that inflation variability is considerably more sensitive to the assumptions made by a non-credible central bank (CN, NN) than it is for a credible central bank (CC, NC). Specifically, in terms of a 95% confidence interval, a non-credible central bank that mistakenly assumes it has credibility will in effect increase the inflation target band width by one percentage point. Even in the event that the non-credible bank responds harshly (NN) there is only a slight increase in output variability compared with the relatively weaker policy response associated with the CN case. Therefore, in a world where the central bank has no credibility, it is preferable to implement a prudent monetary policy in order to substantially reduce inflation variability without incurring a significant increase in output variability.

While inflation and output stabilisation are of particular concern, some consideration should be given to the behaviour of interest rates and the exchange rate. Not surprisingly, a non-credible central bank that correctly assumes it has no credibility will generate increased instrument variability. In such a case, the central bank will believe it

needs to respond strongly in order to re-anchor inflation back to the target therefore increasing the volatility of the policy instrument. Similarly, the exchange rate will also experience increased variability, but to a slightly smaller extent. This highlights the potential costs associated with stringent monetary policies implemented to return inflation back to target as quickly as possible following a disturbance in an attempt to enhance credibility. Such a rapid adjustment to the inflation target carries the potential to threaten financial market stability. As mentioned previously, in order to specifically avoid such economic instability, Svensson (1997a) argues that the central bank should ideally set an unofficial intermediate target in order to facilitate a gradual adjustment and to minimise the resulting instrument and exchange rate volatility.

Similarly, the implications of credibility misperceptions for a truly non-credible central bank indicated by the RMSDs is reinforced by the resulting mean deviations of each of the four variables from their respective equilibrium (or target) values as shown in Table 9.2. On average, inflation will be 0.6 of a percentage point above target for a bank that mistakenly assumes it has credibility, while a prudent non-credible central bank (NN) will slightly undershoot the target. Again, the absence of any compensatory increase in output loss normally associated with a harsh policy response highlights the preference for a prudent approach to monetary policy for a non-credible central bank.

Furthermore, given the predominance of inflationary shocks over history, policy will remain tight on average as indicated by the positive mean deviations of the instrument from its deterministic equilibrium value. As expected, the prudent non-credible central bank (NN) will maintain slightly higher interest rates than its optimistic counterpart (CN). Accordingly, the exchange rate will be over-valued on average due to the higher interest rates.

In terms of the policy implications for a truly credible central bank (CC, NC), errors are relatively more costly than they are for a non-credible bank, but remain insignificant in absolute terms. Referring back to Table 9.1, the gain from assuming a prudent approach to monetary policy for a credible central bank (NC versus CC) in terms of reduced inflation variability is slightly smaller than for a non-credible bank (NN versus CN). Furthermore, a prudent credible central bank will increase output variability to a small

extent due to its harsh policy response to disturbances. Despite the fact a non-credible central bank will not face such a trade-off between inflation and output variability, the increased output variability for the prudent credible central bank is reasonably small in absolute terms. Therefore, a truly credible central bank is also better off to assume it has no credibility and to accordingly implement relatively harsher monetary policies.

As for a prudent non-credible central bank, a prudent credible bank will also generate slightly higher instrument and exchange rate variability than if it assumed it had credibility. Similarly, policy remains tight on average and the exchange rate appreciated. Overall, in absolute terms there is basically little difference across all four worlds to warrant a definitive conclusion on the effects of credibility misperceptions on the exchange rate and the interest rate.

However, as suggested by the RMSDs, a truly credible central bank that assumes it has no credibility (NC) will suffer a slightly higher output loss than if it correctly assumed it had credibility (CC). Such a misperception will result in an inflation rate lower than the target on average and a marginally greater deviation in absolute terms.

Thus a central bank that initially suffers from a lack of credibility should implement consistently prudent policy (NN) in an attempt to establish a reputation for fighting inflation. Such an approach will ultimately enhance credibility and therefore reduce output variability albeit to a small extent and the NC outcome will be achieved. In the long run, the bank will become aware of the fact it now has credibility and will act accordingly (CC) reducing both the deviation of output from potential and the deviation of inflation from target.

Therefore, while the actual achievement of central bank credibility is important, whether the central bank is aware of its true level of credibility is relatively less important. Given the actual level of credibility a central bank has, it would seem that the bank would be better off to adopt a prudent approach to monetary policy by assuming it has no credibility. While such a harsh policy stance would normally be considered costly in terms of increased output variability, the results from this particular experiment suggest

these costs are relatively insignificant for a credible bank and basically non-existent for a non-credible central bank.

Two further experiments were conducted using FPS in an attempt to determine whether this result is sensitive to the level of credibility used in the analysis. While the results discussed above rely on the assumption that the weight on the inflation target in expectations is equal to either zero or 0.2 depending on the world, the following two scenarios analyse the possibility of slightly higher (but still less than perfect) credibility of 0.4 and slightly lower credibility of 0.1. Obviously, the differing levels of credibility will have no effect on outcomes in the NN world since a weight of zero is placed on the target in expectations in both the bank's forecasting model and in the real world. The RMSDs and mean deviations of all three scenarios are presented in Tables 9.3 and 9.4 respectively.

In the case where the weight assigned to the target in inflation expectations is equal to 0.1 in either the central bank's forecasting model (CN), in the real world (NC) or in both models (CC) the irrelevance of policy errors is even more apparent. Given the true level of credibility of the central bank, a bank that assumes it has no credibility and therefore adopts a stringent approach to monetary policy will generate no more output variability than if it assumed it had credibility. In fact, for a non-credible central bank, inflation variability will be reduced by acting prudently with exactly the same minor increase in output loss as before. While a credible central bank will not only experience exactly the same amount of output variability regardless of its assumption on credibility, it will fail to reduce the variability of inflation. The irrelevance of policy errors in both cases is also reflected in the identical mean deviations of output from potential. Furthermore, a policy error for a credible central bank will, on average, overshoot the inflation target by the same amount as it would if the bank knew the truth. This is perhaps due to the fact that the level of 0.1 selected for this particular experiment to represent partial credibility is not significantly different from zero so that the potential gains from possessing credibility in terms of reducing inflation variability are not substantial.

Table 9.3

Alternative Levels of Credibility

Root Mean Squared Deviations

Variable	CB Assumes it has Credibility		CB Assumes it has No Credibility	
	CB is Truly Credible (CC)	CB is Truly Non-credible (CN)	CB is Truly Credible (NC)	CB is Truly Non-credible (NN)
Inflation				
(C = 0.1)	1.06	1.02	1.06	0.91
(C = 0.2)	**0.87**	**1.16**	**0.73**	**0.91**
(C = 0.4)	1.00	1.51	1.01	0.91
Output				
(C = 0.1)	2.56	2.45	2.56	2.46
(C = 0.2)	**1.93**	**2.45**	**2.02**	**2.46**
(C = 0.4)	2.04	2.52	2.04	2.46
Instrument				
(C = 0.1)	2.16	2.07	2.16	2.41
(C = 0.2)	**1.77**	**1.76**	**2.31**	**2.37**
(C = 0.4)	1.38	1.35	1.38	2.41
Exchange Rate				
(C = 0.1)	5.04	4.83	5.04	4.89
(C = 0.2)	**4.61**	**4.74**	**4.80**	**4.88**
(C = 0.4)	4.69	4.66	4.69	4.89

Table 9.4

Alternative Levels of Credibility

Mean Deviations from Equilibrium

Variable*	CB Assumes it has Credibility		CB Assumes it has No Credibility	
	CB is Truly Credible (CC)	CB is Truly Non-credible (CN)	CB is Truly Credible (NC)	CB is Truly Non-credible (NN)
Inflation				
(C = 0.1)	0.11	0.024	0.11	-0.004
(C = 0.2)	**0.048**	**0.60**	**-0.068**	**-0.004**
(C = 0.4)	0.20	0.24	0.20	-0.004
Output				
(C = 0.1)	-0.55	-0.53	-0.55	-0.53
(C = 0.2)	**-0.38**	**-0.53**	**-0.41**	**-0.53**
(C = 0.4)	-0.35	-0.58	-0.35	-0.53
Instrument				
(C = 0.1)	0.92	0.84	0.92	0.84
(C = 0.2)	**0.68**	**0.72**	**0.52**	**0.84**
(C = 0.4)	0.64	0.64	0.64	0.84
Exchange Rate				
(C = 0.1)	-0.19	-0.19	-0.19	-0.18
(C = 0.2)	**-0.13**	**-0.18**	**-0.11**	**-0.18**
(C = 0.4)	-0.10	-0.19	-0.10	-0.18

* The mean deviations of the inflation rate, the policy instrument and the exchange rate are in terms of percentage points above their respective long-run equilibrium values. The long-run equilibrium value for the inflation rate is the mid-point of the target band (1.5%). The mean deviation of output is the percent deviation from potential. Recall that a negative exchange rate reflects an appreciation.

A similar result is obtained when a weight of 0.4 is assigned to the inflation target in expectations. Again, comparing the credible central banks (CC versus NC) and the non-credible banks (CN versus NN), policy misperceptions surrounding credibility are relatively costless. In each case, output variability remains largely unchanged, regardless of the bank's credibility assumption. However, it is interesting to note that a non-credible central bank (CN versus NN) will substantially reduce inflation variability and even slightly reduce output variability. Secondly, a credible central bank that assumes a prudent approach to policy will if anything, slightly raise inflation variability (compared with CC) while leaving output variability unchanged. However, both of these counter-intuitive results, in terms of the reduction in output variability of the former and increased inflation variability of the latter, are too trivial to warrant any concern.

Comparing all three scenarios, it is not surprising that a non-credible bank that mistakenly assumes a credibility weight of 0.4 will create the largest amount of inflation variability. The higher the assumed level of credibility the bank believes it has, the larger the resulting variability in inflation. In the case where the bank believes agents assign a weight of 0.4 on the target in their expectations, then the policy response will be considerably weaker and inflation more variable given that the true weight agents assign to the target is zero. However, it is interesting to note that in such a case, inflation on average is only 0.24 of a percentage point over target which is not significantly higher than the 0.2 of a percentage point recorded for a credible bank (both CC and NC).

Another interesting point is that while CN experiences increasing inflation variability across the three scenarios as the assumed credibility level increases, inflation variability initially decreases and then increases for a truly credible central bank (CC and NC). This raises the possibility that there exists an optimal level of credibility to possess where inflation variability will be minimised. Further experiments would need to be conducted in order to explore this possibility further. It may even be the case that inflation variability will only be minimised under a less than perfectly credible central bank.

However, it would appear that out of the three levels of credibility considered for the purposes of this analysis, the assumptions of the central bank surrounding their credibility have no significant impact on output variability. In this case, by adopting a prudent approach to monetary policy, inflation variability can be reduced without any significant compensatory increase in output variability.

Chapter 10

Conclusions

Over the past decade the issue of central bank credibility has been widely debated and remains highly controversial. However, it has generally been accepted that agents' perceptions of the integrity of the central bank to commit to the objective of maintaining price stability ultimately contributes to the determination of actual inflation via inflation expectations and official inflation forecasts. It is extremely difficult and perhaps impossible to determine the exact extent to which central bank credibility contributes to actual inflation given the variety of definitions and interpretations that have been used in the literature to date.

The progression of the theoretical literature on central bank behaviour has largely been brought about by advancements in game theory. Specifically, the development of political game theory is largely derived from concepts used to analyse the strategic behaviour of industrial organisations. While this approach is useful in identifying the strategic interaction that occurs between the central bank, the government and the public, game theory itself has limitations of its own in terms of the possibility of multiple equilibria and time horizon sensitivity. Additionally, the important issue of credibility has often been neglected in such analyses by simply being proxied as a constant probability of the central bank reneging on its commitment.

Similarly, the empirical literature analysing credibility has provided conflicting results. This is largely due to the variety of measures that have been used in such studies to proxy credibility. Given that credibility can not be directly observed and therefore not measured, the results from econometric tests using inflation expectations, bond yields and forecast errors as proxies should be approached with caution. While inflation expectations can be considered perhaps the most intuitively appealing measure of credibility, expectations themselves are also extremely subjective and to isolate the credibility component of expectations would prove to be a difficult task.

In order to avoid the spurious results commonly encountered with econometric tests and the inevitable data problems that exist, this analysis has used a dynamic macroeconomic model to determine the way in which credibility uncertainty can influence the central bank's response to disturbances and therefore the ultimate economic outcome. While such an approach may be criticised for being unrealistic, it would seem that given the unquantifiable nature of credibility, an abstraction from reality is necessary in order to separate out the 'noise' of the economy and to therefore identify the underlying mechanism through which credibility can affect a variety of macroeconomic variables.

The question raised in this thesis on the influence of the central bank's assumptions surrounding its level of credibility has been analysed in a stochastic environment. While the central bank observes the combination of random shocks that hit the economy in the current period, they face uncertainty regarding the likelihood of further shocks occurring in future periods. The shocks used for this analysis are based on the historic behaviour of the New Zealand economy and as the results indicate, they account for the predominance of inflationary pressures over deflationary pressures.

The results from the stochastic simulations indicate that credibility is important in determining the stabilisation of key macroeconomic variables following a series of random disturbances. However, it is relatively unimportant whether the central bank knows it has credibility when it is responding to the disturbances. Generally, a vigorous policy response has usually been associated with reduced inflation variability to the detriment of increased output variability. The results here indicate that such a prudent approach to monetary policy can substantially reduce inflation variability without any significant increase in output variability.

By consistently implementing a harsh policy response, not only will inflation variability be reduced, but over time agents will become aware of the bank's strong anti-inflation stance and so credibility will be achieved. In which case, the central bank will ultimately find itself in a world where output variability and output loss are minimised, inflation stabilised and on average basically equal to target. However, such an anti-inflation stance may in fact be de-stabilising in terms of interest rate and exchange rate

variability. While the results hinted that such variability is present, it is relatively minimal.

The arguments for and against a gradual adjustment to the inflation target following a shock is beyond the scope of this thesis. However, it remains an important issue in terms of the desirability of credibility. As mentioned in Chapter 3, a gradual disinflation should not necessarily be interpreted as a lack of central bank credibility. Given the obvious problem associated with unanticipated disturbances continually hitting the economy, an over-zealous policy response may prove to be destabilising. In this case it would seem preferable for the central bank to take a long run view of the impacts of inflation and to aim for inflation stabilisation over the long run rather than continually.

In order to provide a more definitive conclusion supporting the preference for a prudent approach to monetary policy it would be useful to carry out further experiments using FPS, in particular using alternative combinations of credibility levels for the central bank's forecasting model and the real world. It may be that the central bank believes it has a lower but non-zero level of credibility than it has in reality, in which case the counter-intuitive results in the third scenario of the previous chapter may be improved on. Furthermore, it may also be interesting to look into the possibility of the existence of an optimal level of credibility that the central bank should be pursuing given the U-shaped pattern of inflation variability over increasing levels of credibility.

Appendix

VAR impulse response functions
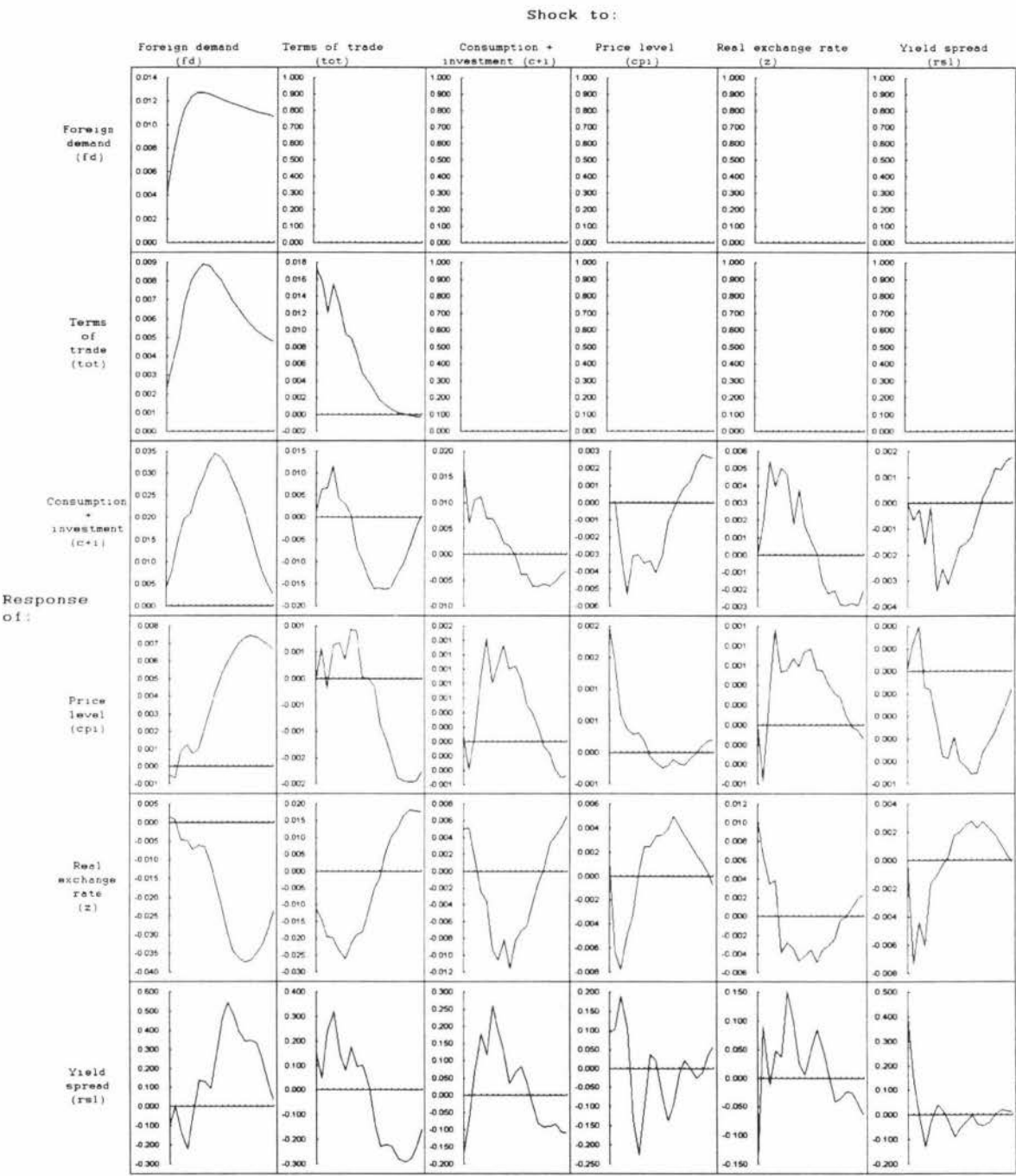
The impulse responses of the variables in the VAR to each of the six shocks are presented above. In all cases the magnitude of the shocks is equal to one standard deviation. The figure should be read vertically; each column shows the response of each variable to a particular shock.[1]

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[1] The graphs and explanation above appear in Conway et al (1998).

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