The Implications of Parameter Uncertainty for Medium-Term Fiscal Planning

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Abstract

Most existing studies on medium-term fiscal planning focus on a single source of uncertainty, which is captured by including additive random error terms in stochastic simulation models. The fiscal authority in these models plans its budget with complete knowledge of the structure of the economy, including the parameters. Abstracting from parameter uncertainty greatly simplifies stochastic simulation experiments, but could lead to misleading policy conclusions for reasons given by Brainard (1967).

This paper investigates how parameter uncertainty influences the results obtained from stochastic simulation studies on medium-term fiscal planning. We compare simulation results obtained from two kinds of stochastic simulation experiments. In the conventional stochastic simulation framework, the fiscal authority faces uncertainty from a single source – additive error terms. In the other stochastic simulation framework, the fiscal authority also involves uncertainty about the parameters of the model. Our results indicate that parameter uncertainty leads to larger forecast errors and thereby makes fiscal planning more difficult. However, we find that one can obtain much the same results by increasing the magnitude of the additive shocks in the model. This implies that the non-linear (multiplicative as opposed to additive) nature of the stochastic parameters plays a relatively minor role in our analysis of fiscal planning. The additive error terms in the stochastic simulation model can therefore be interpreted to capture parameter uncertainty, as well as other sources of uncertainty.

Table of Contents

1. Introduction

The 1998 federal budget introduced the *Debt Repayment Plan,* which is aimed to keep the federal debt-to-GDP ratio on a clear, downward profile. In pursuing this objective, the fiscal authority faces uncertainty that arises from several sources. Uncertainty is currently taken into account by incorporating an explicit level of "prudence" into the fiscal plan. A number of studies have applied stochastic simulation methods to gauge how much "fiscal prudence" would be required to insure against the risk of running a deficit.[1] Two recent studies by Hostland and Matier (2001) and Georges (2001) examine the possibility of keeping the debt-to-GDP ratio within a specified range or under a ceiling that declines gradually over time.

Most of the studies mentioned above focus on a single source of uncertainty, interpreted as unanticipated economic and fiscal developments. This is captured by additive error terms in stochastic simulation models.[2] The fiscal authority in these models plans its budget with complete knowledge of the economy, including all the parameters. This "complete knowledge" assumption has obvious computational advantages, which greatly simplify the task of conducting policy analysis in a stochastic simulation framework. There is a risk, however, that abstracting from model uncertainty could lead to misleading policy conclusions.

Brainard (1967) pointed this out over 30 years ago in his seminal paper.[3] Brainard used a simple static model to show that uncertainty about the monetary policy transmission mechanism could result in a more cautious optimal monetary policy response.[4] Several recent studies have investigated this issue using more advanced

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[1] Boothe and Reid (1998), Robson and Scarth (1999), Dalsgaard and De Serres (1999), and Hermanutz and Matier (2000).

[2] The stochastic simulation experiments conducted by Robson and Scarth (1999) involve uncertainty arising from additive error terms and the parameters, combined. However, they do not analyze the implications of parameter uncertainty, per se.

[3] Holt (1962) made essentially the same point in an earlier paper.

[4] We refer to the monetary policy implications of parameter uncertainty simply in terms of being "more cautious" for presentation purposes. Martin and Salmon (1999) provide a more precise description of how parameter uncertainty affects the optimal monetary policy response by making a distinction between *caution*, *conservatism* and *gradualism*.

stochastic simulation methods and more sophisticated models. Many studies confirm Brainard's finding.[5] There is the question, however, about the empirical importance of these findings. Some papers have found that Brainard's result holds qualitatively, but conclude that parameter uncertainty has relatively minor implications for the setting of monetary policy.[6] Other papers have come to the opposite conclusion, that parameter uncertainty calls for a more aggressive (less cautious) monetary policy response.[7] The mixed nature of these results should not be surprising given that Chow (1975) showed that the effect of parameter uncertainty on the responsiveness of monetary policy is theoretically ambiguous. This line of research demonstrates that Brainard's finding is a special case that cannot be generalized across a wide variety of models and different kinds of parameter uncertainty.[8]

This paper investigates how parameter uncertainty influences medium-term fiscal planning. This entails comparing results obtained from two kinds of stochastic simulation experiments. First, in the conventional simulation framework, the fiscal plan is made in the presence of uncertainty that arises from a single source – additive error terms. We then add parameter uncertainty into the stochastic simulation framework and examine how it affects fiscal policy objectives.

The plan of the paper is as follows. The next section of the paper provides some basic intuition for why parameter uncertainty is important for policy design. Section 3 discusses the stochastic simulation experiments and the calibration methodology used to specify parameter uncertainty in the modelling framework. Simulation results are then presented in section 4. We end by drawing policy conclusions from our analysis.

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[5] Notably, Svensson (1997), Hall et al. (1999), Martin (1999), Martin and Salmon (1999), and Wieland (1998, 2000).

[6] See Sack (1998 and 2000), Rudebusch (1998), Estrella and Mishkin (1999) and Debelle and Cagliarini (2000).

[7] Examples include Soderstrom (1999a), Mercado and Kendrick (1999) and Tetlow and von zur Muehlen (2001).

[8] Soderstrom (1999b) shows analytically that the effect of parameter uncertainty on the optimal monetary policy response depends on the nature of the uncertainty and its interaction with the dynamics of his model. Shuetrim and Thompson (1999) obtain a similar result using empirical methods.

2. The Importance of Parameter Uncertainty for Fiscal Policy Design

2.1 A Simple Stylized Example

The basic intuition underlying our paper can be explained with reference to the simple policy design problem considered by Brainard (1967). The policy maker in Brainard's simple example seeks to set its instrument "p" to minimize a static linear quadratic linear objective function given by:

(1) $$U(p) = (y - y^*)^2 \text{ such that } y = \beta p + u$$

where y is the variable of interest, y* is its target level, β is a parameter that captures the response of y to the policy instrument p and u is a vector of exogenous variables. In the case where β is a fixed parameter, the optimal policy setting p^* is given by:

(2) $$p^* = [y^* - E(u)] / E(\beta)$$

where $E(\beta)$ is the expected value of β and E(u) is the expected value of u. Equation (2) implies that the policy maker sets its instrument to keep y at its target level y*. The optimal policy rule obtained in the fixed parameter case is consistent with the *certainty equivalence* principle.

In the more complex case where the β is a random variable, the optimal policy setting p* is given by:

(3) $$p^* = \{E(\beta)[y^* - E(u)] - \rho\sigma_\beta\sigma_u\} / [E(\beta)^2 + \sigma_\beta^2]$$

where ρ is the correlation between β and u, σ_β is the standard deviation of the random variable β and σ_u is the standard deviation of u. Equation (3) implies that in general it is not optimal for the policy maker to set its instrument to keep y at its target level y* (unless, of course, $\rho = 0$ and $\sigma_\beta = 0$, which is equivalent to the fixed parameter case). The optimal policy setting takes into account the correlation between the policy response parameter β and the exogenous variable u, as well as their variances. The key insight provided by Brainard is that *certainty equivalence* does not hold in the presence of parameter uncertainty.

The question we pose in this paper can be stated simply with reference to the above example considered by Brainard. Suppose that the fiscal plan is made under the (mistaken) assumption that the parameters are known with certainty. What would be the implications for the objectives of fiscal policy?

Before addressing this issue using stochastic simulation methods, we will first discuss the fiscal policy objectives that underlie our analysis.

2.2 Fiscal Policy Objectives

Debt Control

The fiscal authority in our analysis seeks to keep the debt-to-GDP ratio on a clear, downward profile.[9] We refer to this as the *debt control* objective of fiscal policy. Our simulations are performed with reference to a hypothetical scenario where the fiscal authority aims to reduce the stock of debt by $3 billion each fiscal year with nominal GDP growth averaging 4.3 per cent per year. This implies approximately a 20 percentage-point reduction in the debt-to-GDP ratio over a ten-year period. This particular scenario has no special significance in our analysis – it merely serves as a benchmark for conducting stochastic simulation experiments.

Unanticipated economic and fiscal developments are generated by additive error terms in the model. This causes the debt-to-GDP ratio to deviate from the desired level set out in the fiscal plan. We measure the degree of debt control attained by the fiscal authority using a 90 per cent confidence interval for the deviation of the debt-to-GDP ratio relative to the desired level. This represents a probabilistic measure of the range of outcomes that can be achieved, on average.

Policy Smoothing

If debt reduction were the only objective of fiscal policy, discretionary changes could be made to program spending and taxes to keep the projected debt-to-GDP ratio at the desired level over the coming fiscal year. However, this would require large and

[9] The "debt-to-GDP ratio" refers to net federal debt as a proportion of GDP throughout our analysis.

frequent discretionary changes, which would raise the risk of having to "backtrack" on announced tax and spending measures if economic conditions turn out to be significantly weaker than anticipated. A fiscal planning strategy that requires smaller discretionary changes will help ensure that the fiscal authority can carry out its previous spending and tax commitments. This means, however, that it would have to sacrifice its debt control objective. The fiscal authority therefore faces a conflict between its debt control objective and its "policy smoothing" objective.

Economic Stabilisation

At the same time, the fiscal authority seeks to enhance economic stabilisation by implementing a counter-cyclical policy stance. This can be achieved by incorporating automatic stabilisation properties into the tax and transfer system. In addition, the fiscal authority can also make discretionary changes to taxes and program spending in a counter-cyclical manner. This entails increasing the primary budget balance during economic expansions and decreasing the primary budget balance during contractions. However, counter-cyclical discretionary changes to taxes and spending run counter to the debt control objective of fiscal policy. The fiscal authority therefore faces a conflict between its debt control objective and its economic stabilisation objective.

2.3 Fiscal Planning Strategies

We want to investigate how parameter uncertainty influences different fiscal planning strategies. Three alternative approaches are considered. Under one strategy, the fiscal authority aims to run a $3 billion surplus in each fiscal year, regardless of fiscal and economic conditions.[10] This entails preparing the fiscal plan at the beginning of each fiscal year by making discretionary changes to program spending and/or taxes so that the surplus projected over the coming fiscal year is $3 billion. The budget balance deviates from the planned $3 billion level due to unanticipated economic and fiscal developments that arise over the course of the fiscal year. In the subsequent fiscal year, the fiscal authority continues to plan a $3 billion budget surplus. No adjustments are made for past

[10] Our analysis focuses on fiscal planning at the federal level only. The fiscal authority therefore corresponds to the federal government and the fiscal measures refer to the federal level.

fiscal and economic developments. We refer to this fiscal planning strategy as a *flow rule* because it focuses exclusively on the budget balance (the *flow* dimension) and does not respond to unanticipated changes in the debt-to-GDP ratio (the *stock* dimension).

Under the second strategy, the fiscal authority aims to keep the debt-to-GDP ratio at its desired level in each fiscal year. This entails making discretionary changes to spending and/or taxes such that the projected debt-to-GDP ratio over the coming fiscal year is at the desired level. We refer to this as a *strict debt rule* because it focuses exclusively on unanticipated changes to the debt-to-GDP ratio (the *stock* dimension).

Under the third strategy, the fiscal authority aims to bring the debt-to-GDP ratio back to its desired level in a gradual manner. This is implemented using a fiscal policy reaction function of the following form:[11]

$$(b_t - b^*) = \tau(E_t d_{t+1} - d^*) \quad (4)$$

where $(b_t - b^*)$ represents the deviation of the budget balance from its target level (expressed as proportions of GDP) and $(E_t d_{t+1} - d^*)$ represents the expected deviation of the debt-to-GDP ratio from the mid-point of the target range in the coming fiscal year.[12] The parameter τ determines the strength of the fiscal policy response to economic and fiscal developments. A higher value of τ implies a stronger response, which brings the debt-to-GDP ratio back to the mid-point of the target range more rapidly. This acts to dampen fluctuations in the debt-to-GDP ratio in accordance with the debt control objective. Expectations are generated in a forward-looking, model-consistent manner. This assumes full information about the structure of the model, including all the parameters. The control mechanism underlying the policy rule (4) allows the debt-to-GDP ratio to fluctuate in the short term, but ensures that it reverts back to its desired level over the long term.[13]

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[11] The stochastic simulation model is documented by Hostland (2001).

[12] The target level for the budget balance is simply the flow dimension of the mid-point of the debt-to-GDP target range.

[13] See Hostland and Matier (2001) for a more complete discussion of the three fiscal planning strategies.

3. Stochastic simulation experiments

We compare two kinds of stochastic simulation experiments to examine whether parameter uncertainty has important policy implications for medium-term fiscal planning. Stochastic simulation experiments are initially conducted with fixed parameters to derive the fiscal policy trade-off in a setting where uncertainty arises from a single source – additive error terms. We then introduce parameter uncertainty into the stochastic simulation framework and re-examine the fiscal policy trade-off.

3.1 The Conventional Simulation Framework (without Parameter Uncertainty)

The Fiscal Policy Trade-Off

A *flow rule* and a *strict debt rule* can be thought of as two extreme strategies, while a *flexible debt rule* represents a compromise between the two.[14] A *strict debt rule* provides tight debt control at the expense of other fiscal policy objectives, namely "policy smoothing" and economic stabilisation. In contrast, a *flow rule* sacrifices debt control to provide more "policy smoothing" and economic stabilisation. A *flexible debt rule* allows for a continuous range of possibilities between these two extremes. The flexible nature of the rule enables the fiscal authority to strike a balance between the conflicting policy objectives.

We can illustrate the fiscal policy trade-off using the *flexible debt rule*. A higher value of the parameter τ in the fiscal policy reaction function (4) results in a tighter degree of debt control. However, this requires larger and more frequent discretionary changes, which is counter to the "policy smoothing" objective, and results in a less counter-cyclical fiscal policy stance, which is counter to the economic stabilisation objective. Varying the value of τ therefore enables us to trace out the trade-off between the debt control objective and the "policy smoothing" and economic stabilisation objectives. This trade-off is illustrated by Figures 1 and 2 below.

[14] One can imagine other fiscal planning strategies. For example, the policy rule considered by Boothe and Reid (1997) aims for a budget balance averaged over several years. This would result in even less debt control than the *flow rule* used in our analysis.

Figure 1 illustrates the trade-off between the debt control objective and the "policy smoothing" objective. The thin line, labelled "without parameter uncertainty," represents stochastic simulation results obtained in the case where the parameters are known by the fiscal authority in the model. The standard deviation of the debt-to-GDP ratio is measured on the horizontal axis. Moving along this axis toward the origin corresponds to a higher degree of debt control. The standard deviation of discretionary spending is measured on the vertical axis.[15] Moving down this axis toward the origin corresponds to a lower amount of year-to-year fluctuations in discretionary spending, which is desirable for "policy smoothing" purposes. The thin line in Figure 1 illustrates the extent to which the fiscal authority would have to sacrifice debt control in order to gain more in the way of "policy smoothing" (measured by the amount of variation in discretionary spending).

Figure 2 illustrates the trade-off between the debt control objective and the economic stabilisation objective. As in Figure 1, the standard deviation of the debt-to-GDP ratio is measured on the horizontal axis. The standard deviation of the output gap (the percentage deviation of real output from its potential level) is measured on the vertical axis. Moving down this axis toward the origin represents a lower amount of output variability, which is desirable for economic stabilisation purposes. The thin line in Figure 2, labelled "without parameter uncertainty," illustrates the extent to which the fiscal authority would have to sacrifice debt control in order to attain a higher degree of economic stabilisation (measured by the standard deviation of the output gap).

[15] We refer to discretionary changes that are required to implement the fiscal plan as "discretionary spending" for presentation purposes. In practice, discretionary changes could be made to taxes, transfers and/or direct program spending.

Figure 1: Trade-off between Debt Control and "Policy Smoothing" Objectives

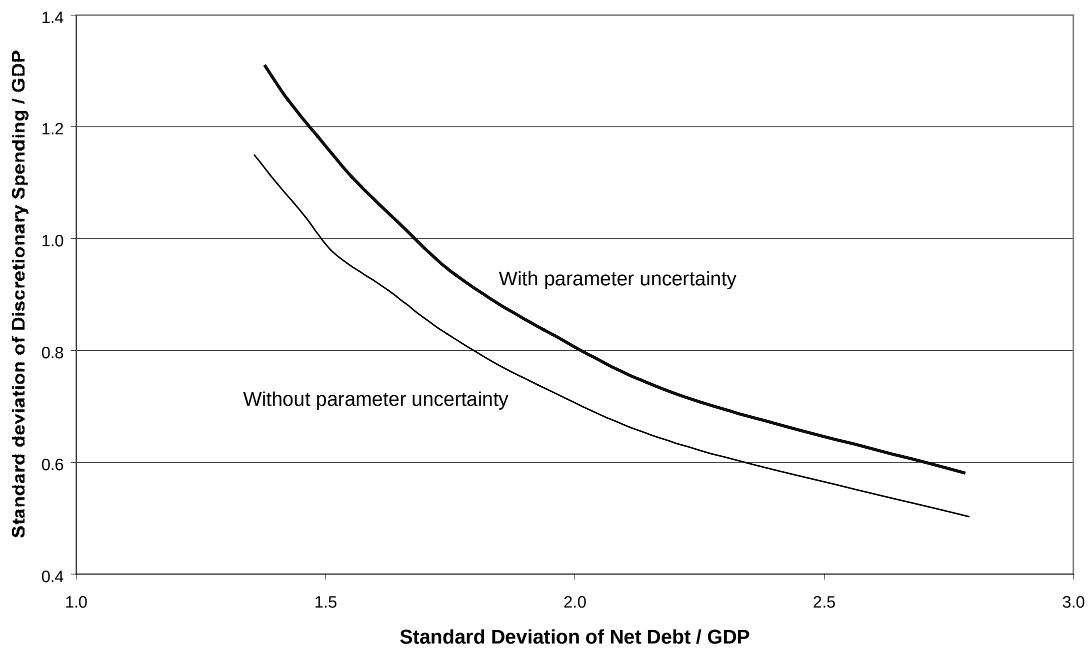
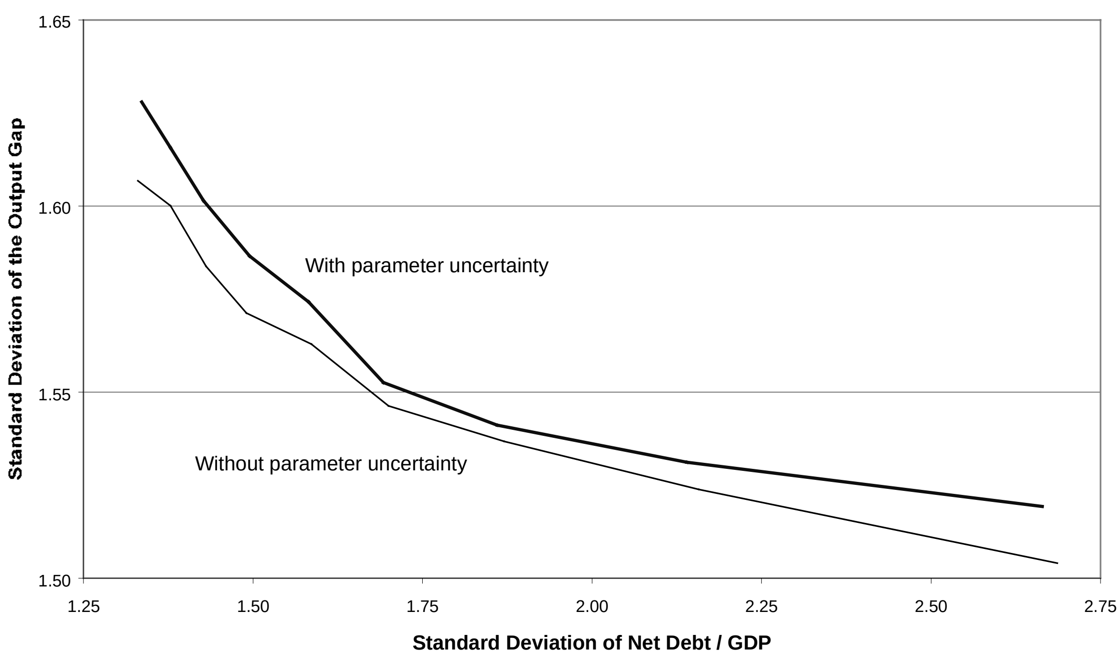


Figure 2: Trade-off between Debt Control and Economic Stabilisation Objectives



We have little idea about what relative weights should be assigned to the conflicting policy objectives. Deriving an "optimal" policy choice is therefore outside the scope of our analysis. Instead, we focus on how the entire fiscal policy trade-off is affected by parameter uncertainty. In particular, we want to determine whether parameter uncertainty alters the policy trade-off in a fundamental way.

3.2 The Simulation Framework with Parameter Uncertainty

Stochastic Simulation Methodology

Parameter uncertainty is introduced into the stochastic simulation framework by adding a stochastic element to the parameters in the model. The amount of stochastic variation in the parameters is calibrated to have a marked influence on the simulation properties of the model. This entailed generating a series of dynamic simulations using stochastic parameter values. The standard deviations of the random error terms[16] added to the parameters were increased to the point where the range of dynamic responses were found to be large, based on casual observation of the impulse responses.

This is illustrated in Figures 3a and 3b for the case of an output shock. Figure 3a shows the dynamic response of selected macro variables to a one standard deviation (0.7 of a percentage point) transitory increase in output. The solid line in each panel represents the mean response of the model,[17] averaged across 1000 dynamic simulations generated with stochastic parameter values. The broken lines shown in Figure 3a represent a 90 per cent confidence interval calculated across the 1000 outcomes. This probabilistic range of dynamic responses illustrates the degree of parameter variation used in the stochastic simulation experiments. Figure 3b shows the probabilistic range of dynamic responses for the fiscal variables, generated in a similar manner.

[16] The error terms are drawn from a normal distribution with a mean of zero.

[17] Because the model and the random error terms are symmetric, the mean dynamic response corresponds to that obtained using the mean values of the parameters.

Figure 3a: Response of Macro Variables to Output Shock

(One standard deviation - 0.7 percentage points - transitory increase in aggregate demand)

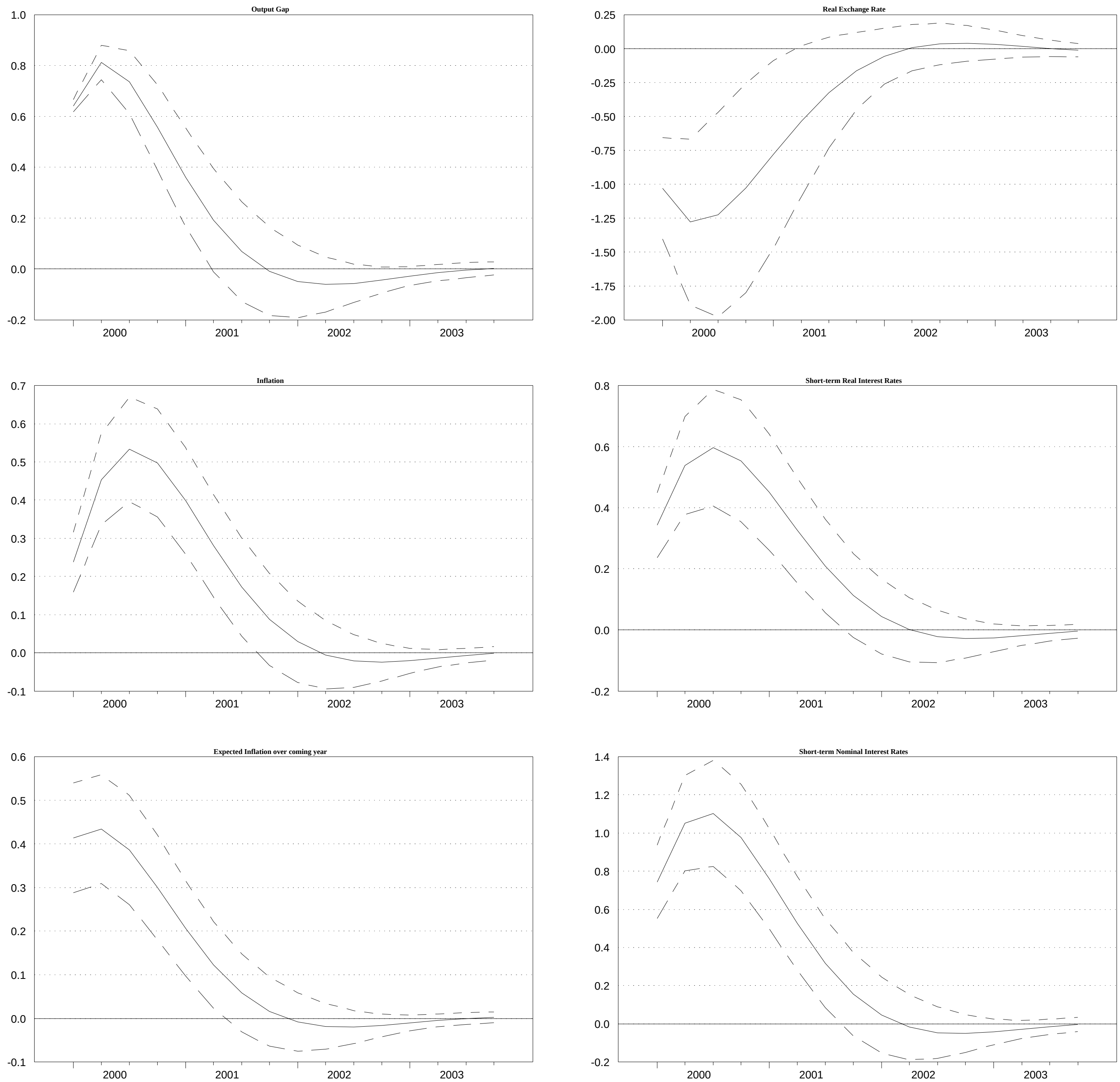
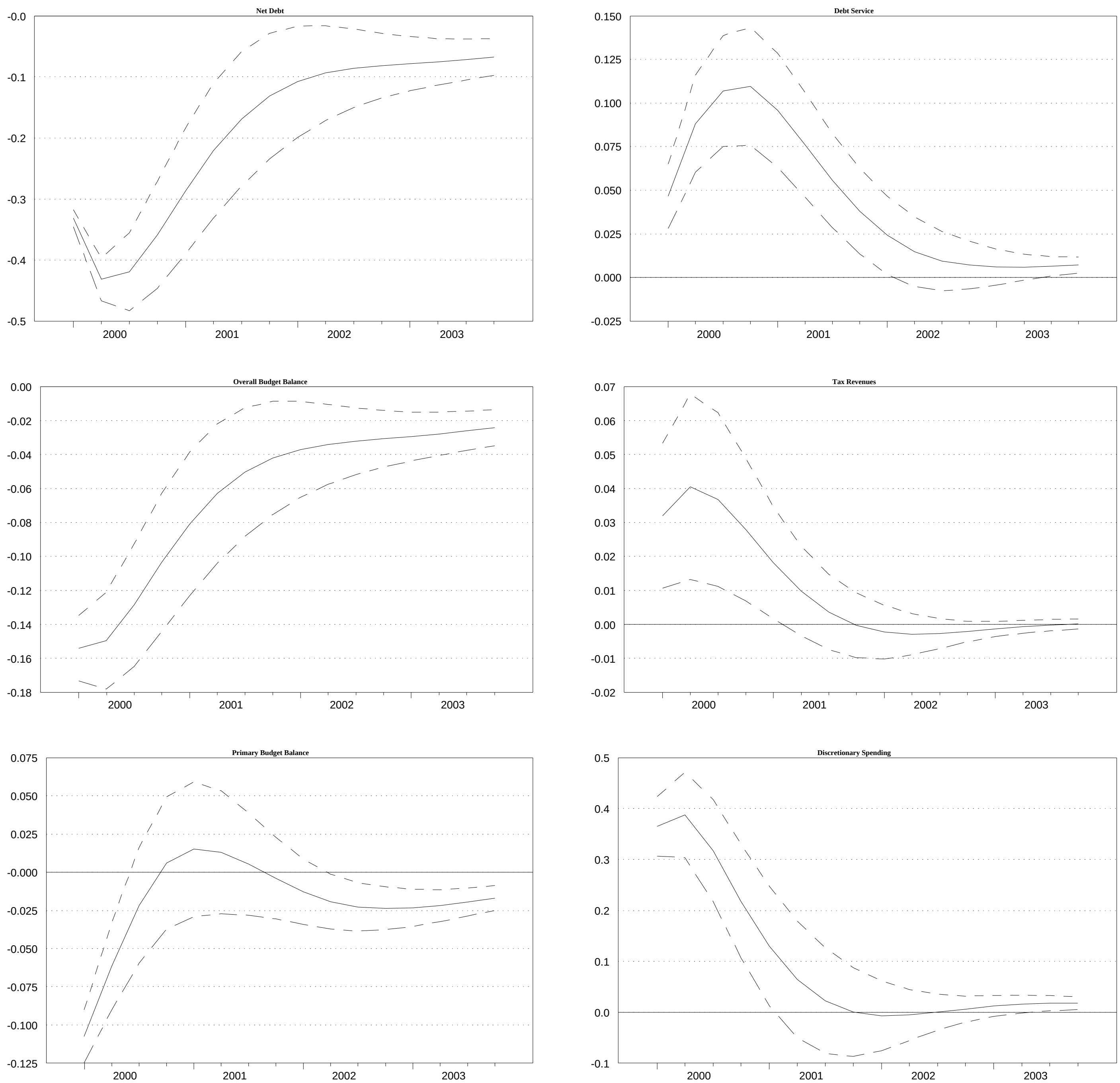


Figure 3b: Response of Fiscal Variables to Output Shock

(Expressed as a percentage of GDP)



It is important to recognize that adding random error terms to the parameters has a multiplicative effect on the model's properties, rather than an additive effect as in conventional dynamic simulations. This can explain why the width of some of the confidence intervals shown in Figures 3a and 3b varies across the simulation horizon.

We examine the implications of parameter uncertainty by comparing two sets of stochastic simulation experiments. In the conventional stochastic simulation framework, the parameters are fixed and known with certainty. The fiscal authority faces only one source of uncertainty, represented by the additive error terms in the model. In the other set of simulation experiments, the fiscal authority also faces uncertainty about the parameters in the model. Parameter uncertainty is introduced into the stochastic simulation framework as follows. The model is simulated over a ten-year planning horizon repeatedly. A random error term is added to each of the parameters at the beginning of each ten-year planning period. The parameters are constant during each ten-year planning period, but vary across repeated planning periods. This can be thought of as a pooled time series-cross sectional data set where parameters are constant in the time series dimension but vary in the cross-section dimension. Economic and fiscal projections are based on the mean values of the parameters, which deviate from the actual values by a stochastic component.

3.3 Stochastic Simulation Results

The Effect of Parameter Uncertainty on Forecast Errors

The presence of parameter uncertainty causes the fiscal authority in the model to make larger forecast errors. This is illustrated in Table 1, which compares root-mean-squared errors (RMSE) of forecasts made in the two stochastic simulation settings (with and without parameter uncertainty). The upper panel in Table 1 reports the RMSE of forecasts at the one-year horizon under a *flow rule* and a *strict debt rule*. The first two rows in Table 1 show that parameter uncertainty makes it more difficult for the fiscal authority to forecast output and inflation at the one-year horizon. This leads to higher uncertainty about the outcome for the budget balance and the debt-to-GDP ratio over the coming fiscal year.

Table 1: Parameter Uncertainty (PU) and Forecast Errors

Root-mean-squared forecast errors at one-year horizon.

	Flow rule		***Strict debt rule***	
	Without PU	*With PU*	*Without PU*	*With PU*
Output	0.91	0.99	0.91	1.14
Inflation	0.41	0.54	0.41	0.59
Budget balance / GDP	0.44	0.49	0.44	0.59
Net debt / GDP	0.40	0.47	0.40	0.53

Root-mean-squared forecast errors at two-year horizon.

	Flow rule		***Strict debt rule***	
	Without PU	*With PU*	*Without PU*	*With PU*
Output	1.47	1.65	2.03	2.52
Inflation	1.08	1.33	1.34	1.70
Budget balance / GDP	0.44	0.49	1.89	2.92
Net debt / GDP	1.06	1.25	0.86	1.40

Note that parameter uncertainty has a stronger influence on forecasting performance under a *strict debt rule* than under a *flow rule*. The intuition for this is as follows. Under a *strict debt rule*, fiscal policy responds much stronger to projected changes in economic and fiscal variables than under a *flow rule*. Larger forecast errors, therefore, have more pronounced economic consequences, which make forecasting even more difficult. The lower panel in Table 1 shows that the decline in forecasting performance is significantly higher at the two-year horizon. This suggests that parameter uncertainty has a stronger influence on fiscal planning strategies that are more activist and more forward-looking.

The Effect of Parameter Uncertainty on the Fiscal Policy Trade-off

Figures 1 and 2 above compare the fiscal policy trade-offs generated by the two sets of simulation experiments. The thin lines correspond to results obtained without parameter uncertainty; the thick lines involve parameter uncertainty. Figures 1 and 2 show that parameter uncertainty worsens the trade-off between the debt control objective and the "policy smoothing" and economic stabilisation objectives. This result is quite intuitive. As shown in Table 1 above, parameter uncertainty leads to larger forecast errors. This makes it more difficult for the fiscal authority to forecast the impact of economic and fiscal developments on the debt-to-GDP ratio over the coming fiscal year. In other words, parameter uncertainty makes debt control more difficult to attain. The fiscal authority can offset the higher amount of uncertainty by planning to bring the debt-to-GDP ratio back to the desired level more rapidly. However, this requires larger discretionary changes and a less counter-cyclical fiscal policy stance, which are counter to the "policy smoothing" and economic stabilisation objectives.

It is important to make a distinction between the total <u>amount</u> of uncertainty and the two different <u>sources</u> of uncertainty in the stochastic simulation experiments. Adding parameter uncertainty raises the total amount of uncertainty facing the fiscal authority in the model. This can account for some of the upward shift in the policy trade-offs shown in Figures 2 and 3. It is not clear, however, whether the non-linear (multiplicative) nature of parameter uncertainty affects the fiscal policy trade-off in the same way as the additive error terms.

We can provide some insight into this question by investigating whether the policy trade-off generated with parameter uncertainty can be approximated by raising the amount of additive uncertainty in the conventional stochastic simulation framework (without parameter uncertainty). We find that this is the case. Increasing the magnitudes of the additive error terms in stochastic simulation experiments conducted without parameter uncertainty results in almost identical policy trade-offs generated with parameter uncertainty. In other words, we find that introducing stochastic parameters into the simulation framework has much the same effect as increasing the magnitude of the additive error terms in the model. This implies that the non-linear (multiplicative) nature of parameter uncertainty does not play a very important role in our analysis.

We also examine the possibility that parameter uncertainty might play a more important role in the case where the fiscal plan is set over a longer planning horizon. This is motivated by the finding that parameter uncertainty leads to considerably larger forecast errors at the two- versus one-year forecasting horizon (reported in Table 1). To investigate this possibility, stochastic simulations are conducted using a fiscal policy rule based on a two-year planning horizon (in place of the one-year planning horizon used to generate the results discussed above). The results confirm our intuition. Parameter uncertainty leads to larger forecast errors when the fiscal plan is set over a two-year planning horizon rather than a one-year horizon. This makes debt control more difficult to achieve and hence, worsens the fiscal policy trade-off. We can replicate this result, however, by increasing the magnitude of the addition error terms in the model. This implies that parameter uncertainty affects the policy trade-off by raising the total amount of uncertainty in the model. The non-linear (multiplicative) nature of parameter uncertainty has relatively minor implications, even over a longer planning horizon.

4. Conclusions

Our simulation experiments demonstrate that introducing parameter uncertainty into a stochastic simulation framework leads to larger forecast errors and thereby worsens the fiscal policy trade-off. We find that one can obtain much the same results, however, by increasing the magnitude of the additive shocks in the model. We therefore conclude that the non-linear (multiplicative as opposed to additive) nature of parameter uncertainty is negligible in our analysis. This implies that the additive error terms in our stochastic simulation model can be interpreted to capture parameter uncertainty (as well as other sources of uncertainty such as unanticipated economic and fiscal developments). Moreover, this finding suggests that the results obtained in previous stochastic simulation studies on fiscal planning are likely to be robust to the type of parameter uncertainty that was used in the stochastic simulation experiments outlined above.

It is important to recognise that our results pertain to medium-term fiscal planning and do not necessarily generalise to other stochastic control problems. Thus, our results cannot be interpreted to either contradict or support previous studies on how parameter uncertainty influences monetary policy objectives. Moreover, it should be emphasized that uncertainty about parameters is but one of several sources of uncertainty surrounding the fiscal planning process. The analysis in this paper was confined to a situation where the policy maker knows the structure of the model, but faces uncertainty about the parameters. This is a convenient assumption for research purposes, but is clearly unrealistic for policy purposes. Uncertainty about the structure of the economy poses an important and difficult challenge to researchers and policy makers. We leave this as an important issue for future research.

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