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Won't Get Fooled Again – Or Will We? Monetary Policy, Model Uncertainty, and 'Policy Model Complacency'

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Abstract

The question addressed in this paper is: can monetary policy succeed in stabilizing the economy even when the policy model on which it is predicated is mis-specified? Using variants of the 3-equation New Consensus Macroeconomics model, it is shown that this question can be answered in the affirmative. The purpose of the paper is not to encourage indifference towards model uncertainty, however, but rather to warn against the perils of "policy model complacency". This arises if the success of policy is misinterpreted as successful understanding of the workings of the economy, which makes the policy maker vulnerable to surprises: events with systematic origins in the "true" model of the economy that are not anticipated by the (mis-specified) policy model. To safeguard against this problem, policy makers should always entertain eclectic views of the workings of the economy – a task that is easily accomplished by paying more attention to "outside the mainstream" macroeconomic thinking that frequently makes predictions that are at odds with those of the dominant policy model.

JEL codes: E12, E13, E52, E58
Keywords: Monetary policy, central banking, model uncertainty, Lucas critique, Tinbergen principle

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1 Introduction

Prior to the onset of the Great Recession, macroeconomics was in thrall to the idea of a "Great Moderation", according to which there had been a marked reduction in the cyclical volatility of economies since the 1980s. This coincided with the notion that, aided by the New Consensus Macroeconomics (NCM), monetary policy had been refined to the point of a science (Clarida et al., 1999). Since the onset of the Great Recession, however, the NCM has been much criticized as a "fair weather" model that over-simplified real-financial interactions in the economy and, as a consequence, led policy makers astray (Goodhart, 2009, pp.826-7).[1] This experience raises important questions about policy models and the potential vulnerability of policy makers to model uncertainty.

The purpose of this paper is to examine the role of policy models in the formulation of successful monetary policy. Using variants of the 3-equation NCM model, we show that it is possible for modern monetary policy to work even if the macroeconomic model on which the central bank bases its policy interventions is mis-specified. In what follows, "modern monetary policy" is understood to consist of an interest rate operating procedure (IROP) on the basis of which the central bank changes the interest rate in response to deviations of one or more macroeconomic variables from their target values. Monetary policy is understood to work, meanwhile, if it succeeds in stabilizing the economy – more specifically, if it results in the movement of targeted macroeconomic variables towards their target values. The paper therefore provides an examination of the efficacy of monetary policy in the face of policy model uncertainty, suggesting that the latter need not be an impediment to successful policy. The ultimate message, however, is not to encourage indifference towards model uncertainty, but instead to warn against the perils of "policy model complacency". Specifically, it is suggested that: (a) precisely because policy may work even when the underlying policy

[1] Perhaps not surprisingly, then, the question as to whether the Great Moderation was, in fact, a product of good policy or merely good fortune remains vexed (see, for example, Galí and Gambetti (2009)).

model is mis-specified, central banks are vulnerable to "surprises" – that is, events with systematic origins in the "true model" of the economy that are not anticipated by the policy model; and (b) to avoid vulnerability to such surprises, central bankers would be well advised to entertain eclectic views of how the economy operates. This can be achieved by paying more attention to models that lie outside the mainstream of macroeconomic thinking, and that make predictions that are very often at odds with those of the dominant model on which policy making is based.

The remainder of the paper is organized as follows. The next section outlines the basic 3-equation NCM model on which the exercises in the rest of the paper are based. Sections 3 and 4 then examine the consequences for monetary stabilization policy of two different examples of policy model mis-specification. The first involves mis-specification of the IS curve, the second mis-specification of the Phillips curve. Section 5 reflects on the lessons to be drawn from the results of the two previous sections, the chief among which is that the ability of successful stabilization policy to survive policy model mis-specification should not encourage policy model complacency. Finally, section 6 concludes.

2 A basic 3-equation model

Both examples of the consequences for monetary stabilization policy of policy model mis-specification examined in this paper are derived from (extensions to) the following generic variant of the 3-equation NCM model.[2]

[2]The focus here is on the "mechanics" of the NCM model (as outlined by Carlin and Soskice (2005), for example) rather than its optimizing micro-foundations (on which see Clarida et al. (1999) among others). Under the rubric established by Krugman (2000), this is a suitable choice of technology given the focus of what follows on the implications for stability (rather than the welfare implications) of policy model mis-specification. See also Setterfield and Gouri Suresh (2014) for a more general defense of aggregate structural macroeconomic analysis.

2.1 The IS curve

The IS curve, relating the interest rate to the level of output, takes the following form:

$$y = A - \delta r$$

$$r = b + m$$

$$\Rightarrow y = A - \delta(b + m) \tag{1}$$

where y denotes output, r is the commercial loan rate, b is the base (overnight) interest rate set by central bank, and m is the mark up applied to b by commercial banks (so that $m = r - b$ is the spread between the central bank's overnight rate and the commercial loan rate). All variables are in real terms.

2.2 The Phillips curve

The Phillips curve, written as a relationship between inflation and real output (rather than the rate of unemployment) is stated as:

$$p = \psi + \phi p^e + \alpha y \tag{2}$$

where p and p^e are the actual and expected rates of inflation, respectively. Note that if we set $\phi = 1$, $p^e = p_{-1}$, and $\psi = -\alpha y_n$ (where y_n denotes the natural level of output determined on the supply-side of the economy), then the Phillips curve in (2) can be re-written as:

$$\dot{p} = \alpha(y - y_n) \tag{3}$$

In this case, the Phillips curve is vertical in inflation-output space ($\dot{p} = 0$ yields the unique equilibrium output solution $y = y_n$) and the accelerationist hypothesis applies: any lasting

deviation of y from y_n will cause inflation to increase or decrease without limit.

2.3 The interest rate operating procedure

The central bank's reaction function or *interest rate operating procedure* (IROP) takes the following form:

$$\dot{b} = \lambda(p - p^T) + \mu(y - y^T) \tag{4}$$

In general, then, the central bank changes the base interest rate in response to deviations of inflation and/or output from their target levels (p^T and y^T, respectively), where $y^T = y_n$ in the event that the Phillips curve is vertical (as in equation (3)).

3 Monetary policy with a mis-specified IS curve

We begin by assuming that the "true" model of the economy consists of equations (1) and (3), augmented by:

$$m = -\eta b \tag{5}$$

Equation (5) is a simplified version of the endogenous commercial bank mark up modeled by Setterfield and von Seekamm (2012). It is consistent with the hypothesis that commercial banks perceive an information asymmetry between themselves and the central bank, and act on the basis of this perception. Specifically, commercial banks believe that the central bank has more and/or better information about the likely future state of the economy than they do themselves. As a result, they raise their mark ups if the central bank cuts its overnight rate, interpreting a cut in b as an indication of a weakening of the general state of the economy, and hence an increase in the risk of default, and hence an increase in lenders' risk. This

behavior is in keeping with empirical evidence which suggests that in the US, the Federal Funds rate is negatively correlated with credit spreads (Weise and Barbera, 2009).

The policy model used by the central bank, meanwhile, is assumed to consist of equations (1) and (3), augmented by:

$$m = \bar{m} \tag{6}$$

Substituting equation (5) into equation (1) reveals that the IS curve in the "true" model is:

$$y = A - \delta(1 - \eta)b \tag{7}$$

whereas that used by the central bank in its policy model, based on equations (1) and (5), is:

$$y = (A + \delta\bar{m}) - \delta b \tag{8}$$

The IS curve used by the central bank is clearly mis-specified. In fact, the policy model used by the central bank is vulnerable to the Lucas critique, since it involves the central bank taking as given (in equation (6)) a "parameter", m, that is actually endogenous to its own policy variable, b (in equation (5)). Blind to this issue, and therefore thinking itself to be confronting nothing more than a conventional 3-equation NCM reality (represented by equations (3) and (8), the central bank therefore conducts monetary policy using the IROP in equation (4) (with $y^T = y_n$).

What are the implications for stabilization policy? It follows from equation (7) that:

$$\dot{y} = -\delta(1 - \eta)\dot{b}$$

Substituting equation (4) into this expression yields:

$$\dot{y} = -\delta(1-\eta)[\lambda(p - p^T) + \mu(y - y_n)] \tag{9}$$

Meanwhile, it follows from equation (3) that:

$$\dot{p} = \alpha(y - y_n) \tag{10}$$

Solving equations (9) and (10) under the equilibrium conditions $\dot{y} = \dot{p} = 0$ yields the equilibrium solutions $y = y_n$ and $p = p^T$. In other words, the system possesses a unique equilibrium consistent with policy maker's target values of inflation and output. At the same time, it follows from these same equations that:

$$\mathbf{J} = \begin{bmatrix} -\delta(1-\eta)\mu & -\delta(1-\eta)\lambda \\ \alpha & 0 \end{bmatrix} \tag{11}$$

Inspection of the Jacobian in (11) reveals that the (in)stability of the economy is crucially affected by the endogeneity of rate spreads to the overnight rate ($\eta \neq 0$), since $\mathbf{Tr}(\mathbf{J}) = -\delta(1-\eta)\mu$ and $\mathbf{Det}(\mathbf{J}) = \delta(1-\eta)\lambda\alpha$. This is, of course, precisely the behavioral feature of the commercial banking sector to which the central bank's policy model fails to attend. Note, however, that both $\mathbf{Tr}(\mathbf{J}) = -\delta(1-\eta)\mu < 0$ and $\mathbf{Det}(\mathbf{J}) = \delta(1-\eta)\lambda\alpha > 0$ as long as $\eta < 1$. The system is therefore stable as long as the commercial bank's reaction to changes in the overnight rate is not "too large" (specifically, as long as it is somewhat less than proportional). While this condition might be violated during a time of economic and financial crisis (such as that experienced from late 2007 through early 2009, for example), it otherwise appears plausible.

The upshot of this analysis is, therefore, that the central bank's mis-specification of its policy model does not prevent successful execution of monetary policy. The intuition behind this result is straightforward. Stabilizing the economy requires that the real commercial

interest rate rises (falls) in response to the central bank increasing (decreasing) the overnight rate (the so-called Taylor principle). Although the behavior of commercial banks in equation (5) acts against this, it will not (in general) so completely offset the central bank's policy interventions as to set up a destabilizing *indirect* relationship between the overnight rate and the commercial rate. The central bank is therefore free to practice successful stabilization policy in blissful ignorance of the endogeneity of commercial bank behavior to its policy variable. Note that given the nature of the model mis-specification entertained, the result in this section also serves to demonstrate that the Lucas critique does not always matter. Even when the problem posed by the critique exists (as it does in this exercise, by design), it need not thwart successful policy intervention.

4 Monetary policy with a mis-specified Phillips curve

Suppose now that the "true" model consists of equations (1), (2), and (6) augmented by:

$$\dot{p^e} = -(1-k)(p-p^T) \tag{12}$$

Following Lima et al. (2014), equation (12) describes the expected rate of change of inflation ($\dot{p^e}$). This is seen to vary inversely with the product of: (a) the difference between the actual and target rates of inflation ($p - p^T$); and (b) the fraction of *credulous agents* in the population ($1-k$), whose inflation expectations are anchored to the policy target, p^T (so that $p^e_c = p^T$ where c denotes a credulous agent). (The remaining fraction of the population, k, consists of *incredulous agents* who are assumed to set their inflation expectations adaptively in accordance with the currently observed inflation rate, so that $p^e_i = p$ where i denotes an incredulous agent). Equation (12) is derived as follows.[3] The expected change in the

[3]In this paper, the fractions of credulous and incredulous agents in the population are taken as given, as in Lima and Setterfield (2008). See Lima et al. (2014), however, for treatment of k as evolving endogenously in accordance with a satisficing evolutionary dynamic.

rate of inflation is a weighted average of the change in inflation expected by incredulous agents ($\dot{p}_i^e$) and the change in inflation expected by credulous agents ($\dot{p}_c^e$). In other words, $\dot{p}^e = k\dot{p}_i^e + (1-k)\dot{p}_c^e$. As credulous agents expect the convergence of current inflation to the policy convention, p^T, while incredulous agents expect inflation to remain unchanged from its current rate, it follows that $\dot{p}_c^e = p^T - p$ and $\dot{p}_i^e = 0$. Substituting these expressions for $\dot{p}_c^e$ and $\dot{p}_i^e$ into the equation for $\dot{p}^e$ stated previously yields equation (12).

The policy model used by the central bank, meanwhile, is now assumed to consist of equations (1), (3) and (6) augmented by:

$$p = p^T \tag{13}$$

The rationale for equation (13) is that, following Lima et al. (2014), the central bank assumes that the rate of inflation is managed by a different policy authority using a non-monetary instrument (such as formal indexation or, as in Lima et al. (2014), an incomes policy). It therefore perceives its role as being only to adjust real output towards the target value of output y^T (which it interprets – incorrectly in view of equation (2) – as the natural level of output, y_n) in order to eliminate inflationary/disinflationary pressure arising from the (perceived) operation of the accelerationist hypothesis in equation (3). In view of all this, the central bank adopts the IROP:

$$\dot{b} = \mu(y - y^T) \tag{14}$$

In this case, the central bank's mis-specification of its policy model appears to render policy making vulnerable to the problem associated with violation of the Tinbergen principle,[4] according which there need to be as many policy instruments as targets. Because of the trade-off between p and y in equation (2), *ceteris paribus* the target level of output y^T will be

[4]See Tinbergen (1952).

consistent with the target rate of inflation p^T only by chance. By using one policy instrument (b) to (implicitly) pursue *two* policy targets, the central bank is thereby unknowingly guilty of using too few instruments to pursue too many policy targets.

Once again, the critical question is: how does this affect stabilization policy? Combining equations (1) and (6) yields:

$$y = (A + \delta\bar{m}) - \delta b$$

from which it follows that:

$$\dot{y} = -\delta\dot{b}$$

Substituting equation (14) into this expression yields:

$$\dot{y} = -\delta\mu(y - y^T) \tag{15}$$

Meanwhile, it follows from equation (2) that:

$$\dot{p} = \phi\dot{p^e} + \alpha\dot{y} \tag{16}$$

Here, the actual change in inflation depends on the expected change in inflation and the actual change in output. Substituting the descriptions of $\dot{p^e}$ and $\dot{y}$ in equations (12) and (15), respectively, into equation (16), we arrive at our final expression for the rate of change of inflation:

$$\dot{p} = -\phi(1 - k)(p - p^T) - \alpha\delta\mu(y - y^T) \tag{17}$$

Solving equations (15) and (17) under the equilibrium conditions $\dot{y} = \dot{p} = 0$ yields the equilibrium solutions $y = y^T$ and $p = p^T$. We again see that a unique equilibrium configuration

exists, consistent with the target values of output and inflation. Furthermore, it follows from these same equations that:

$$\mathbf{J} = \begin{bmatrix} -\delta\mu & 0 \\ \alpha\delta\mu & -\phi(1-k) \end{bmatrix} \tag{18}$$

As is evident from the Jacobian in (18), since $\mathbf{Tr}(\mathbf{J}) = -(\delta\mu+\phi[1-k])$ and $\mathbf{Det}(\mathbf{J}) = \delta\mu\phi(1-k)$, the (in)stability of the economy is clearly sensitive to an aspect of the "true" model ($k \neq 0$) that the central bank has failed to incorporate into its policy model. Since $\mathbf{Tr}(\mathbf{J}) = -(\delta\mu + \phi[1-k]) < 0$ and $\mathbf{Det}(\mathbf{J}) = \delta\mu\phi(1-k) > 0$ as long as $k < 1$, however, the system is stable as long as inflation expectations remain heterogeneous – specifically, as long as at least some private sector decision makers remain credulous and continue to invest faith in the inflation target p^T as an anchor for their inflation expectations. While this condition might be violated during a period of increasing inflation and enhanced inflation volatility (such as was experienced during the 1970s), it otherwise appears reasonable, especially in light of survey evidence suggesting that there exist persistent differences in inflation expectations within the private sector.[5]

It is once again the case, then, that a mis-specified policy model does not prevent successful execution of monetary policy. This time, the nature of the model mis-specification means that the result derived in this section also serves to demonstrate that the Tinbergen principle, according to which the successful execution of policy requires at least as many policy instruments as there are policy targets, does not always apply. One policy instrument (b) apparently suffices to pursue two policy targets (p^T and y^T). The intuition behind this result is that there are, in fact, *two* adjusting variables in the system (b and p^e), one of which is adjusted by the central bank, the other adjusting unbeknownst to the central bank (whose policy model overlooks its adjustment) in accordance with private-sector behavior.

[5]See Lima et al. (2014, pp.257-63) for a recent survey of this literature.

It is the combined adjustment of these variables that stabilizes the economy. To be more precise, the *limited* adjustment of $\dot{p}^e$ implied by heterogeneous inflation expectations, as a result of which $\dot{p}_i^e = 0$ and the expected change in the rate of inflation is rendered "sticky", complements central bank interventions in such a way as to make the latter sufficient for the successful prosecution of monetary policy.[6] As a consequence, even when the Tinbergen principle is violated (as it is in this exercise, by design) it need not thwart successful policy intervention.

5 Monetary policy, model uncertainty, and the perils of "policy model complacency"

The analysis in the preceding sections presents monetary authorities with both good and bad news. The good news is obvious: the efficacy of modern monetary policy is at least somewhat robust to policy model mis-specification, and is therefore invulnerable to at least some sources of model uncertainty.

The bad news is rather more subtle, emanating as it does from the potential for the good news outlined above to give rise to 'policy model complacency'. As has been illustrated, central bank policy may succeed even when the central bank's understanding of the macroeconomy is in some way deficient or incomplete. The danger, then, is of the success of policy being misinterpreted as success in understanding the underlying workings of the economy itself, when in fact it need indicate no such thing. Policy makers may be tempted to celebrate successful policy as an indication of their successful understanding of the economy, without their actually knowing the "true model" governing macroeconomic outcomes

[6] This result dovetails with one of the key conclusions reached by Mankiw et al. (2004) (whose "sticky information" model (Mankiw and Reis, 2002, 2003) provides a rational-choice alternative to the satisficing explanation of heterogeneous expectations in Lima et al. (2014)) that, whatever its source, disagreement may be of vital consequence for macrodynamics.

at all. The resulting 'policy model complacency' creates vulnerability to surprises: events with systematic origins in the workings of the "true" model, and that are not anticipated by the mis-specified policy model used by the central bank, that arise whenever aspects of the "true model" that are hidden form the view of policy makers assert themselves.

Both of the models developed in sections 3 and 4 provide examples of this vulnerability to surprise. In section 3, the necessary condition for stability – that $\eta < 1$ – may be plausible in general, but may cease to be true in particularly turbulent times. In the event that η does, indeed, become "too large" in this fashion (so that $\eta \geq 1$ – i.e., rate spreads become strongly counter-cyclical), the difference between the "true" model and the central bank's mis-specified policy model will assert itself to the central bank's disadvantage. A monetary policy that previously appeared to be working seamlessly (thus appearing to validate the central bank's policy model) will suddenly cease to stabilize the economy. Similar events will unfold in the model discussed in section 4 if p^T loses all credibility with the private sector so that we observe $k = 1$. Once again a monetary policy that previously appeared to be working flawlessly (thus again appearing to validate the central bank's policy model) will suddenly cease to stabilize the economy. Not only do the conditions under which monetary policy will cease to work in sections 3 and 4 have intuitive behavioral interpretations (rate spreads become strongly counter-cyclical; policy-makers' inflation target loses all credibility as an anchor for inflation expectations), it also possible to imagine real-world circumstances under which these conditions have emerged (the 2007-09 financial crisis and the Great Inflation of the 1970s, respectively). Indeed, the 2007-09 financial crisis can be interpreted as a case study of the problems associated with policy model complacency. In this case, a dominant policy model featuring neither banks nor the possibility of default (on which see Goodhart (2009, pp.826-7)) misrepresented macroeconomic performance based on rising (but latent) financial fragility as being part of a Great Moderation. The eventual manifestation of financial fragility as the crisis broke therefore came as a major surprise to policy makers, and a variety of

"unconventional" policy responses (including bail outs of financial corporations and massive fiscal stimuli) were required to avert the onset of a full-blown depression.

What all this suggests is that policy makers need to entertain more eclectic views of how the economy functions in light of the fact that the efficacy of monetary policy does not, in and of itself, substantiate the notion that the central bank correctly understands the "true model" of the economy. Such eclectic thinking would help safeguard against, for example, the endogenous emergence of the downside consequences of financial fragility and systemic instability in circumstances where the central bank's policy model does not admit such possibility, and the (initial) efficacy of monetary policy appears to corroborate the central bank's model.

Fortunately, it would be very easy for central banks to engage in such eclectic thinking. There is no shortage of "heterodox" macroeconomic models that differ fundamentally from the still-dominant NCM model, both with respect to their basic behavioral structures and their resulting descriptions of how the economy works. These models are, moreover, provided free of charge by the academy. The results of this paper suggest that they amount to a free insurance policy against the downside risks of policy model mis-specification. Even if it is not accepted that "heterodox" models should displace the NCM model as the "workhorse" model of monetary policy analysis, having policy makers pay more attention to these models would certainly appear to involve low or no cost coupled with substantial potential gain, and therefore be of unambiguous net benefit to society.[7]

[7]One need only think of the welfare losses entailed by the Great Recession, and the significant advantages that would have resulted from some anticipation of its possibility by policy makers, to justify this last claim. Anticipations of a macroeconomic crisis resulting from the precipitous deterioration of household balance sheets were freely available in the work of Godley and Izurieta (2002) and Palley (2002), for example, but went unheeded in the run-up to the Great Recession.

6 Conclusions

There has been no lack of expressions of discontent with macroeconomic theory since the onset of the financial crisis and Great Recession.[8] These have included calls for wholesale abandonment of the New Consensus DSGE model that dominates modern monetary policy analysis. The conclusions reached in this paper are rather more modest, but remain important nonetheless. They suggest that even if calls for the abandonment of the NCM model go un-heeded by monetary policy makers, there remains a clear-cut case for paying more attention to heterodox macroeconomic models in policy circles. Not only are such models provided at no cost to central banks by the academy, they frequently suggest systematic tendencies in the workings of the economy that are not present in (or even consistent with) the operation of DSGE models. As such, paying closer attention to them amounts to obtaining free insurance against the downside risks inherent in "policy model complacency" – the condition associated with over-confidence in a potentially mis-specified policy model resulting from the successful practice of monetary policy. As the events of 2007-09 and the ensuing Great Recession testify, the upside gains of adhering to this simple policy rule are potentially enormous.

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[8] See, for example, Colander et al. (2008), Goodhart (2009), and Dutt (2011) for representative examples of this discontent.

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