COMMENTS ON "MONETARY POLICY UNDER UNCERTAINTY IN MICRO-FOUNDED MACROECONOMETRIC MODELS," BY A. LEVIN, A. ONATSKI, J. WILLIAMS AND N. WILLIAMS

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1. Introduction

The 1970s and the 1980s were tough decades for researchers studying the effects of monetary policy and optimal monetary policy responses to exogenous disturbances. In fact, Lucas (1976) famous critique challenged the usefulness of (or, better, highlighted problems with) econometric models for policy evaluation. Moreover, Lucas (1987) monograph about the very low cost of business cycle fluctuations implicitly questioned the relevance of optimal stabilization policy exercises.

Providing convincing responses to Lucas has taken quite some time. Dynamic stochastic general equilibrium (DSGE) modeling should be thought as a (partially) successful effort in that direction. The presence of explicit micro-foundations has made possible the use of these models for policy analysis and the importance for welfare of heterogeneity, in

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the form of price and wage dispersion, has made again meaningful the problem of optimal monetary policy.

Exactly in the context of these micro-founded DSGE models, the work of Levin, Onatski, Williams and Williams (LOWW) conducts a careful and detailed analysis of optimal monetary policy and the robustness of optimal rules. The model adopted in the paper is a large-scale model of the business cycle with various nominal and real frictions (as in Christiano, Eichenbaum, and Evans (2005)) and many exogenous shocks (following along the lines of Smets and Wouters (2003)). In order to determine the importance of each friction and each disturbance in the generation of the business cycle, the model is estimated on U.S. quarterly data.

LOWW's analysis delivers four main conclusions. First, the welfare costs of macroeconomic fluctuations are sizable and wage dispersion is the main source of welfare losses. Second, a simple rule in which the central bank responds only to wage inflation achieves almost the same welfare level of the Ramsey policy. Since the Ramsey policy can have quite complicated representations, finding a simple rule approximating the truly optimal policy is an important contribution. Third, the optimality properties of this simple rule are robust to the uncertainty about many structural parameters of the model. Forth, exactly because the labor market is very important in the model, the optimal simple rule is not very robust to alternative assumptions about wage rigidity.

For its approach and the interesting results, the paper sets a very high standard for the analysis of optimal monetary policy. Nevertheless, some of the aspects of the paper deserve further discussion.

I will organize my comments in two points. In the first part I will argue that the specific rule proposed in the paper is not implementable because it implies a very high volatility of the nominal interest rate. I will suggest some alternative rules which are similar to the one recommended by LOWW, but are operational. In the second part I will comment more broadly on the problem of optimal monetary policy in likely misspecified models. In both sections, I will ague that more work is needed, in order to provide a compelling reply to Lucas.

2. Optimal Simple Rules and the Zero Bound

One potential problem with the specific optimal monetary policy rule proposed in the paper is that it implies a very high volatility of the nominal interest rate. Suppose that the LOWW model is augmented with the following class of interest rate rules

$$R_t = R_{t-1} + \phi_w \Delta W_t, \tag{2.1}$$

where R_t and ΔW_t denote respectively the nominal interest rate and wage inflation. Table 1 reports the volatility of the annualized nominal interest rate corresponding to several values of ϕ_w, the coefficient of reaction to wage inflation. It is evident that stronger reactions to wage inflation generate a higher volatility of the monetary policy instrument.

Insert table 1 here

Notice that to $\phi_w = 3.2$, which is the value recommended by LOWW, corresponds a volatility of the nominal interest rate of almost 8 percent per year. This number seem too high. In fact, when the inflation target is zero and the steady state real rate of interest is four percent (as in the paper), this policy rule would imply hitting the zero bound of nominal interest rates with approximately a 30 percent chance. This makes the simple rule suggested by LOWW not operational (I borrowed this terminology from McCallum and Nelson (1999)).

In some sense this is not a very surprising result, since the problem is common to optimal policy exercises based on linearized models, in which the optimal policy implies a variability of some of the variables for which the linear approximation becomes invalid. Of course, one solution for the monetary authorities would be to replace the policy rule (2.1) with the following modified version

$$R_t = \min\left\{R_{t-1} + \phi_w \Delta W_t; 0\right\}, \tag{2.2}$$

which does not violate the zero bound constraint. However, this would cause an increase in the variability of output, price and wage inflation which would make (2.2) suboptimal.[1]

One alternative solution for the central bank would be to raise its inflation target, in order to increase the average of nominal interest rates and, therefore, decrease the probability of hitting the zero bound. Table 2 reports the inflation rate that the central bank should target in order to have the average nominal interest rate at least two standard deviations away from zero (again as a function of ϕ_w).

Insert table 2 here

As should be expected, the inflation target increases with ϕ_w, capturing the idea that the stronger the reaction to wage inflation, the higher the variability of interest rates, the higher the inflation target necessary to be away from the zero bound with a high probability. In particular, notice that to the optimal value suggested by the authors ($\phi_w = 3.2$) corresponds an inflation target of approximately 11.5 percent, which, again, seems very high. On the other hand, if the central bank wants to keep an inflation target of zero, the reaction to wage inflation should be reduced to 0.45, a value considerably lower than 3.2.

Since to make the wage targeting rule operational the reaction to wage inflation has to decrease drastically, one could even question the optimality of the wage targeting rule suggested by LOWW. In particular, one alternative rule that would perform better under the zero-inflation-target and the zero bound constraint[2] is a rule exhibiting *superinertia*, i.e. a coefficient of reaction to the past level of the interest rate bigger than one. The intuition for the optimality of superinertia is the familiar one: if the central bank credibly commits to an extremely strong reaction to fluctuations in wage inflation, this will affect private agents' expectations formation, resulting in an ex-post lower variability of the interest rates. This allows to increase the coefficient on wage inflation with respect to the case in which the coefficient on past interest rate is constraint to be one. Interestingly, numerical exercises show that the result of the paper that a mute response to the output gap and price inflation is optimal continues to be valid.

This simple exercise has a potentially broader interpretation, indicating that the problem of the optimal inflation target and the optimal variability of price and wage inflation are strictly related and probably should not be analyzed separately. Although LOWW work under the assumption that the optimal inflation target is zero, their welfare function could be easily modified in order to consider the possibility of a positive inflation target. The problem of doing so is that the general type of model adopted by LOWW is not completely suitable to analyze the effects of a positive steady state inflation. Indeed, the only effect that inflation has on welfare is through price and wage dispersion and the model abstracts completely from alternative sources of gains and costs like, for example, shoe-leather costs, fiscal implications, advantages in terms of flexibility of real wages etc... All these issues seem to me at least of the same order of magnitude for welfare as the effects due to the variability of inflation examined in the paper.

3. Optimal Monetary Policy in (Likely Misspecified) DSGE Models

In this section I will comment more broadly on the problem of optimal monetary policy in models which are "grossly deficient relative to the ideal" (Faust (2005)). I want to stress that this section of the discussion should be understood as more related to the entire strand of literature rather than specific to this paper and that, more than a set of criticisms, these should be regarded as suggestions for future developments.

The great achievement of modern DSGE models à la Christiano, Eichenbaum, and Evans (2005) or Smets and Wouters (2003) is being competitive in terms of fit with statistical models like vector autoregressions.[3] However, we should not forget that this improvement in fit comes at the cost of debatable assumptions about the presence of some frictions and some shocks that do not have a clear micro-foundation. Some examples are rule-of-thumb agents, adjustment costs in investment, price and wage indexation. While this point has been made before (see, among others, Faust (2005) and Sims (2003b)), it is worthwhile repeating it because one important contribution of LOWW's paper is the sensitivity analysis of optimal interest rate rules to the value of specific structural parameters of the model (capturing specific frictions). This allows to identify the features of the models that are important for the robustness of optimal rules. Interestingly, optimal rules seem sensitive exactly to some of the frictions lacking a clear microeconomic interpretation, like adjustment costs in investment or assumptions about the particular kind of wage rigidity.

3.1. **An example of potential misspecification: price and wage indexation.** Notice, however, that there is also a deeper sense in which the model could be misspecified. If this was the case, simply showing the robustness of the policy rule to the uncertainty about the exact level of the coefficients would not be particularly reassuring. I will illustrate this point by focusing on the issue of price and wage indexation, for a reason that will become clear at the end of the section.

In many modern DSGE models with price and wage rigidities, when price and wage-setters cannot re-optimize, they are assumed to set prices and wages according to a simple indexation rule. The indexation rule is called dynamic when prices and/or wages are indexed to past inflation and static when indexed to long run or average inflation. Combinations of the two extremes are also possible, like in this paper.

In a recent study, Schmitt-Grohe and Uribe (2004) emphasize the fact that the particular assumption about indexation play a key role for the design of optimal rules. When indexation is fully dynamic, the optimal rule does not exhibit inertia, while if indexation is less than fully dynamic, the optimal rule has interest rate inertia and sometimes (like in our case) superinertia. Therefore, it could be argued that the best way to proceed would be to determine empirically what the right degree of indexation is. Notice, however, that finding the degree of indexation that fits the data best is exactly the same sort of "cavalier treatment of expectations" that Lucas has so convincingly criticized in the 1970s. There is no "right" degree of indexation. People probably behave as in a dynamic indexation model in periods in which inflation is highly autocorrelated. On the other hand, static indexation would be more natural when the autocorrelation is low. This is just another way of saying that the degree of indexation is an endogenous object and that any model in which the degree of indexation is exogenous should not be considered a truly structural model.

If this was indeed the case, analyzing the sensitivity of optimal policy rules to the exact degree of price and wage indexation would not be the relevant exercise. This is because the right model would be one without any exogenous indexation, but with a completely different expectations formation process for the private agents. Clearly, all these considerations are potentially very important for the design of optimal monetary policy.

3.2. **Learning, frictions and persistence.** Here I am not necessarily trying to argue that the assumptions about price and wage indexation are more important than other features of the model for the design of optimal policy. Instead, the reason why I chose to digress on indexation is simply because it makes a natural link to what I regard as a very promising avenue for future research.

What is strange and puzzling in many modern DSGE models is that in the same economy there is a group of agents who are so intelligent and with such a perfect information that their behavior can be well approximated by rational expectations. At the same time, there is another group of agents behaving not only not optimally, but in a very incoherent way. Both assumptions seem too extreme and I wonder whether it would not be more desirable to model all agents as rationally bounded in a more systematic way.

Learning has enormous potential in this respect. After all, Sargent (1999), Orphanides (2000), Primiceri (2005) and Sargent, Williams, and Zha (2004) among others have shown how learning can greatly improve our understanding of policymakers' behavior in the postwar period. More recently, in the context of a small-scale monetary model, Milani (2005) has shown that a model in which private agents learn over time fits the data better than a model in which agents have rational expectations. Moreover and most importantly, Milani (2005) shows that some of the exogenous frictions, that sometimes are necessary in a model with rational expectations to improve the fit and generate the persistence observed in the data, become redundant when agents are assumed to learn over time. As argued for example in Orphanides and Williams (2004), optimal policy under the assumption of rational expectations can perform quite poorly when agents are actually learning.

More generally, modelling the way people process information and form beliefs in a more complex way than the one implicit in the assumption of rational expectations seems crucial in order to reproduce some of the features of the data in a theoretical model (see, for instance, Sims (2003a) or Mackowiak and Wiederholt (2005)). Clearly, integrating learning and even more sophisticated assumptions about the formation of agents' beliefs in large-scale models like the one presented in this paper represents a challenge, but should be considered a priority for future research.

Notes

[1]In the context of the FRB/US model, Reifschneider and Williams (2000) argue that the use of a rule similar to (2.2) would yields only small stabilization costs.

[2]Here, again, I follow Rotemberg and Woodford (1998) and Schmitt-Grohe and Uribe (2004) in imposing the nonnegativity constraint by requiring that the nominal interest rate is at least two standard deviations away from the zero bound. This is just a computationally convenient approximation and, ideally, one should impose the nonnegativity constraint directly, as in Eggertsson and Woodford (2003).

[3]In Smets and Wouters (2003) (as well as LOWW), one important shortcoming that makes the model competitive with VARs in terms of fit is detrending and demeaning the data in advance (i.e. ignoring the restrictions implied by the balanced growth path). This is clearly undesirable.

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	ϕ_w										
	.1	.2	.3	.4	.45	.5	1	1.5	2	3	3.2
$\sigma(R_t)$	1	1.32	1.64	1.88	2	2.16	3.32	4.36	5.4	7.32	7.72

Table 1: Volatility of annualized nominal interest rates (percentage points)

	ϕ_w						
	.45	.5	1	1.5	2	3	3.2
π^*	0	.32	2.64	4.72	6.8	10.64	11.44

Table 2: Inflation target necessary to avoid the zero bound (percentage points)

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