Journal of Economic Dynamics & Control 33 (2009) 1296–1313

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

# Wage or price-based inflation? Alternative targets in optimal monetary policy rules

Massimiliano Marzo *

*Dipartimento di Scienze Economiche, Università di Bologna, 2, Piazza Scaravilli, 40126 Bologna, Italy*

ARTICLE INFO

*Article history:*
Received 28 March 2003
Accepted 23 October 2008
Available online 31 January 2009

*JEL classification:*
E52
E63
C68

*Keywords:*
Welfare
Nominal and real rigidities
Capital accumulation
Inflation targeting
Output targeting

ABSTRACT

In this paper the optimality of a specific variant of monetary policy rules *à la* Taylor is tested within a general equilibrium monetary model with both nominal and real rigidities. The traditional Taylor rule is amended by the inclusion of the growth rate of nominal wage, or 'wage inflation'. Nominal rigidities are inserted via quadratic adjustment costs for both prices and wages *à la* Rotemberg [1982. Sticky prices in the United States. Journal of Political Economy 90, 1187–1211] and Kim [2000. Constructing and estimating a realistic optimizing model of monetary policy. Journal of Monetary Economics 45, 329–359]. Cost of capital adjustment together with a positive steady state inflation rate allow the model to match the main empirical facts about US economy. The model is solved by using a second order approximation around the non-stochastic steady state, as in Kim et al. [2008. Calculating and using second order accurate solutions of discrete time dynamic equilibrium models. Journal of Economic Dynamics and Control 32 (11), 3397–3414]. The welfare metric is offered by the second order expansion of the utility function conditional to the non-stochastic steady state. The results show that wage inflation targeting is welfare improving when coupled with inflation targeting. Moreover, optimal monetary rules include also a positive coefficient for output targeting, as the need to smooth out quantity adjustments induced by real and nominal rigidities. Similar results occurs when both targets are in expected value one period-ahead. The model shows good in sample and out of sample properties.



## 1. Introduction

The present paper studies optimal monetary policy rules in a large-scale dynamic stochastic general equilibrium model with nominal and real rigidities. The monetary policy rules here studied belong to the interest rate pegging rule, of the type proposed by Taylor (1999), and studied by Judd and Rudebusch (1998), Clarida et al. (2000), and Woodford (2003), among others. The goal here is to test: (i) if the inclusion of an additional measure of nominal tension, here represented by 'wage inflation' is welfare improving; (ii) how far from the inflation targeting coefficient should the wage inflation targeting coefficient should be, in order to reach optimality. The main results can be summarized as follows: (i) optimal monetary policy is always characterized by a mixed target of both inflation and wage inflation, no matters if monetary authority targets current inflation or expected inflation; (ii) the optimal coefficient of both wage inflation and inflation should be the same, below the values recommended by other existing studies, (iii) conditional to the optimal policy, the coefficient on output is positive and slightly bigger than what has been showed in the literature (see, for example Schmitt-Grohé and Uribe, 2005, 2007a, b) (SGU henceforth); (iv) impulse-response functions based on the full second order solution of the model show a good internal sample forecast power and large persistence of nominal and real variables after a shock (either technology-base of policy-based).

* Tel.: +39 51 2098019; fax: +39 51 2098040.
*E-mail address:* massimiliano.marzo@unibo.it

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doi:10.1016/j.jedc.2008.10.009

The model is approximated up to second order and it is solved in order to capture an accurate welfare metric based on the second order expansion of the utility function of the representative agent conditional to the non-stochastic steady state of the model, according to the methods proposed by Kim et al. (2008). The specific class of Taylor-type rules including also a sort of 'wage inflation', given by the growth rate of nominal wages includes an additional nominal target for monetary authority together with output a lagged value for the interest rate itself. Growth rate of nominal wages seems to be an important source of analysis in the conduct of the central bank, as witnessed by many speeches of central bankers and policy makers. However, there are not many studies aiming to test the welfare performance of a monetary rule including also another nominal target such as the growth rate of nominal wage.

Our framework shares several features of the existing literature on dynamic stochastic monetary models. In particular, the presence of a large set of nominal and real rigidities, like in Christiano et al. (2005) and Schmitt-Grohé and Uribe (2005, 2007a, b), allows to capture a substantial degree of persistency in the model. In this spirit, the model includes price and wage rigidities, as well as investment adjustment costs. On the other hand, the specification taken here are inspired by quadratic costs of price and wages originally proposed byRotemberg (1982) and adapted by Hairault and Portier (1993) and Kim (2000) to DSGE, rather than the Calvo method. Money is inserted via transaction costs in the representative agent's budget constraint: this approach allows to mitigate the strong inflation stabilization bias resulting from models where money is directly inserted into the utility function as a strongly separable argument. The interplay between many sources of stickiness makes possible the liquidity effect after a monetary policy shock, as well as the general inertia characterizing real and nominal variables, as documented by Leeper and Sims (1994) and Sims (1998). Empirically observed large inertial patterns can be interpreted as the results of information gluts: the presence of a high level of heterogeneity in both the labor and goods markets makes the process of discovering the general price level a non-trivial task from the perspective of a single agent. The large amount of information to be processed within a limited amount of time is a source of stickiness, either in price or in wages or in both, as outlined by Zbaracki et al. (2004). If we accept this interpretation, the assumption of the quadratic cost of price and wage adjustment costs becomes more appealing, rather than alternative methods of modelling rigidities, because of the explicit dependence of costs on the economic context, instead of modelling the deterministic fixed cost of changing prices and/or wages.[1] The analytical framework adopted in this paper belongs to the general type of models under the spirit of the new neoclassical synthesis (NNS, henceforth), as described by Goodfriend and King (1997). The class of models including only price rigidities shows a clear rationale for strict inflation targeting, as described in Rotemberg and Woodford (1997); King and Wolman (1996). On the other hand, Erceg et al. (2000) have shown that if wage inertia is adopted to a standard model, strict inflation targeting is no longer optimal, and central bank should also react to changes in nominal wage or in the output gap. Canzoneri et al. (1983) explained this result by stressing the fact that monetary policy makes wage movements unnecessary. Wage inflation is a nominal targeting which helps to stabilize prices, too. The reverse is not necessarily true, instead, i.e.: targeting only inflation is not optimal.Canzoneri et al. (2005) (CCD, thereafter) provide additional evidence on the importance of wage inflation targeting in a similar setting. The underlying model is different than that considered in the present paper, with respect to several assumptions on price, wage and investment adjustment costs as well as for the type of welfare measure and solution method (based on Dynare). Their results prove the optimality of wage inflation targeting with respect to price targeting: under this respect, our paper shares with CCD (2005) the view that wage inflation should be an explicit target for monetary authority. However, CCD (2005) do not find an additional role for inflation targeting *together* with wage inflation. In the present context, instead, we prove that inflation targeting is important *together* with wage inflation targeting, and the two nominal measures are not mutually exclusive, as it is the case in CCD (2005). Differently from CCD (2005), in the present paper we also search for the optimal monetary policy configuration for monetary policy rules with expectation terms for both inflation and wage inflation. The solution method employed here differs from that introduced by SGU (2005), and Juillard (2001). However, our results seem to be coherent with what has been obtained by other studies, such as CCD (2005).

The rest of the paper is organized as follows. The next section contains a description of the main assumptions concerning households and firms. The assumptions relative to policy sector (monetary and fiscal policy) are contained in Section 3, while in Section 4 we discuss the core characteristics of the equilibrium of the model economy as well as the calibration strategy. A brief discussion of the solution method together with welfare metric employed is reported in Section 5. Section 6 contains the results divided up into two parts: optimal monetary policy analysis and impulse-response functions. Section 7 concludes. Technical details about solution method is left to a technical appendix, available upon request.

## 2. The model

### 2.1. Households

The economy is populated by an infinite number of agents indexed on the real line between 0 and 1 by *i*. Each *i*-th agent formulates preferences about consumption $C_{it}$ and labor effort $L_{it}$. The stream of utility of each *i*-th agent is given by

$$U_{it} = E_t \sum_{t=0}^{\infty} u(C_{it}, L_{it}) \tag{1}$$

[1] In the existing literature, prices and wages are generally modelled via the Calvo (1983) method. Although this approach has sound microfoundations, rigidities turn out to be independent from the economic environment and appear to be driven by exogenous forces.