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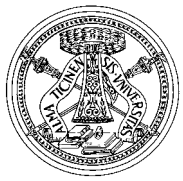

Quaderni di Dipartimento

The Long-run Optimal Degree of Indexation in the New Keynesian Model

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The Long-run Optimal Degree of Indexation in the New Keynesian Model

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Abstract

This note shows that full price indexation is not optimal in the long-run in the New Keynesian model. Moreover, we show that more price stickiness may increase steady state welfare, if price indexation is partial.

JEL classification: E31, E52.

Keywords: Indexation, Optimal Monetary Policy Rules, New Keynesian model

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1 Introduction

Indexation of wages and prices was the subject of substantial literature in macro in the era of high inflation (see the seminal paper by Gray, 1976) and it has subsequently been neglected. Quite recently, however, many authors start introducing various forms of indexation in the New Keynesian model, within the Calvo price staggering framework.

However, they do it in a completely *ad hoc* manner. First, the nowadays most popular form of indexation embedded in these models is the so-called backward-looking indexation. The main reason is empirical in order to have a lagged term in the New Keynesian Phillips Curve to match the inflation persistence in the data. Second, indexation is most of the times assumed to be full, which avoids the problems arising with positive inflation in steady state (see Ascari, 2004). In the empirical estimates of these models, however, indexation is usually found to be only partial.

This short note looks at the second issue, while leaving the first one to further research. That is, we do not ask which is the best form of indexation in these models. Instead, we deal with the following question: given that we assume backward looking indexation (as most of the recent literature), is full indexation optimal in the long-run?

In order to do that, we use the Christiano et al. (2005) (CEE henceforth) model, which is quite rich and empirically successful. Since indexation is usually not assumed to be state contingent, in this note we restrict our analysis to the steady state of the CEE model. We will then ask which are the values of price and wages indexation that maximize welfare in the deterministic steady state of the CEE model.

2 The Model

The version of the CEE model we use is exactly the one described in Schmitt-Grohé and Uribe (2004), p. 4-23. Its main features are: (i) *Households*: habit persistence in consumption, money in the utility function, each household comprises all the type of labors and owns capital stock, sticky wages a la Calvo; (ii) *Firms*: Cash-in-advance constraint on wage payments, monopolistic competition, price stickiness a la Calvo, standard Cobb-Douglas production function plus a fixed cost to guarantee zero profit in equilibrium, variable capacity utilization, adjustment costs in investment; (iii) Government expenditure is financed through lump-sum taxes and seigniorage.

We use the same functional forms, notation and calibration of Schmitt-Grohé and Uribe (2004) (see Table 1 therein).

In this note we focus on indexation, which in the CEE model takes the popular form of backward-looking indexation. In other words, those prices (and wages) that can not change are automatically updated accordingly to the level of price (wage) inflation in the previous period.

3 Steady State Optimal Indexation

Both CEE and Schmitt-Grohé and Uribe (2004) assume that both wages and prices are fully indexed, that is indexation is 100%. In this note we ask the model what are the values of $\chi \in [0,1]$ (i.e., degree of price indexation) and of $\tilde{\chi} \in [0,1]$ (i.e., degree of wage indexation) that maximize the steady state welfare of the representative household.

We expected to find full indexation (i.e., χ,$\tilde{\chi} = 1$) to be optimal in steady state, since, as in Schmitt-Grohé and Uribe (2004), steady state inflation is calibrated to be equal to US average inflation (4.2%). Figure 1 shows welfare as a function of χ and $\tilde{\chi}$, immediately revealing two main results: (i) no indexation gives the worst outcome; (ii) wage indexation is much more important than price indexation for welfare. Indeed, price indexation does not affect welfare very much, for a given level of wage indexation ($\tilde{\chi}$); while the welfare surface is quite sensitive with respect to changes in $\tilde{\chi}$, given χ.

Moreover a quick look at Figure 1 seems to confirm the expectation of the optimality of full indexation. However a more careful inspection of the actual numbers shows that this is, rather surprisingly, not the case.

Result 1 The maximum welfare level is attained at $\tilde{\chi} = 1$ and $\chi = 0.88$, that is, full wage indexation, but only partial price indexation.

Figure 2 uncovers this main result. Indeed, steady state welfare is ever increasing in the wage indexation parameter, $\tilde{\chi}$, but for a given $\tilde{\chi}$, it is first increasing and then decreasing in the price indexation parameter, χ. It follows that for any $\tilde{\chi}$, full price indexation is never optimal. Moreover, even more surprisingly

Result 2 For *any* level of $\tilde{\chi}$, the value of $\chi = 0.88$ maximizes steady state welfare.

As shown in Figure 1, given $\tilde{\chi} = 1$, the change in steady state welfare from $\chi = 0.88$ to $\chi = 1$ is admittedly quite small: from -156.7106 to -156.7143.[1]

In order to explain the intuition of the non optimality of full price indexation, we can follow the line of argument in King and Wolman (1996). King and Wolman (1996) focus their attention on the average mark-up in the economy. Generally speaking, we can think the average mark-up as a measure of the monopolistic distortion in the whole economy, i.e., a lower average mark-up should be associated with a higher welfare level. Moreover, recall that, like all the New Keynesian models, monopolistic competition implies that also in a flexible price economy, the average mark-up is above one because of the monopolistic distortion.

The average mark-up can be expressed as

$$\frac{P_t}{MC_t} = \left(\frac{P_t}{\tilde{P}_t}\right)\left(\frac{\tilde{P}_t}{MC_t}\right) \tag{1}$$

where MC_t = nominal marginal costs, P_t = aggregate price level and $\tilde{P}_t$ = the optimal reset price.

The average mark-up is hence given by two factors: 1) the "price adjustment gap", defined as the ratio of the general price level to the price charged by resetting firms; 2) the "marginal mark-up", defined as the mark-up of the resetting firms.

Recall that we are analyzing the steady state and that inflation is positive (i.e., 4.2%). In a full indexation environment all the prices and wages will be the same in a steady state. So there is no "price adjustment gap" and the average mark-up is equal to the marginal mark-up, in turn simply given by the Lerner coefficient. Whenever there is

[1] However, this change is bigger than the changes induced by changing the kind of monetary policy in the Schmitt-Grohé and Uribe (2004) Table 2. This fact led us to investigate if there can be bigger welfare gain in changing the indexation parameters, rather than changing the Taylor rule parameters (see Ascari and Branzoli, 2006).

partial price indexation instead this is no longer true, and the steady state exhibits price dispersion. In this environment P_t is lower than $\tilde{P}_t$ and a price adjustment gap emerges. Indeed with partial indexation, positive inflation mechanically erodes the relative price set by firms in past periods. This is very simply implied by the steady state version of the equation that defines the general price level

$$\begin{aligned} P_t &= \left[\int_0^1 {P_{i,t}}^{1-\eta} di\right]^{\frac{1}{1-\eta}} = \left[\alpha \pi_{t-1}^{(1-\eta)\chi} P_{t-1}^{1-\eta} + (1-\alpha)\tilde{P}_t^{1-\eta}\right]^{\frac{1}{1-\eta}} \Longrightarrow ss \\ \Longrightarrow \quad 1 &= \left[\alpha \overline{\pi}^{(\eta-1)(1-\chi)} + (1-\alpha)\left(\frac{\tilde{P}_t}{P_t}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}} \\ \Longrightarrow \quad \frac{\tilde{P}_t}{P_t} &= \left(\frac{1-\alpha\overline{\pi}^{(\eta-1)(1-\chi)}}{1-\alpha}\right)^{\frac{1}{1-\eta}} \end{aligned} \tag{2}$$

Note that, other things equal, *lower* price indexation increases $\frac{\tilde{P}_t}{P_t}$, since firms will try to shield themselves from the erosion of relative prices. Thus the price adjustment gap *increases*, in turn decreasing the average mark-up in (1), and increasing welfare. Here it is therefore the positive effect of partial indexation: the lower χ, the lower the price adjustment gap and the lower the average mark-up in the economy.

The second effect instead concerns the marginal mark-up, which is also affected by partial indexation. Firms know that positive inflation erodes both their mark-up (since nominal marginal costs will increase with inflation) and their relative prices. This latter erosion would both increases their demand (which they have to satisfy by assumption) and decreases their per-unit profits. They thus react, by resetting a higher price when they can, so that the lower the indexation parameter, the higher the ratio $\frac{\tilde{P}_t}{MC_t}$. Here is the negative effect of a lower indexation on the average mark-up in the economy: the lower χ, the higher the marginal mark-up and the higher the average mark-up in the economy.

These are the two conflicting forces acting in steady state. As displayed in Figure 3, for low levels of χ, the second effect dominates such that the average mark-up decreases with χ, and therefore welfare is increasing with indexation. However, at a certain point ($\chi = 0.88$), the two effects exactly compensate and then the first effect takes over, such that the average mark-up is now increasing, while welfare is instead decreasing with χ.

Following the same argument, the second effect instead always dominates with regard to wage indexation, given our calibration.

To conclude, with positive trend inflation, partial price indexation can minimally correct the monopolistic distortion in the steady state, thereby increasing welfare.

3.1 Price indexation and price stickiness

It would be interesting to look at the properties of the steady state defined by the optimal combination of the two indexation parameters, particularly exploring the comparative statics with respect to some parameters. The most obvious one is the Calvo parameter of the price setting mechanism, because price indexation is only partial. The parameter α is the probability of not being able to reset the price, and thus $(1-\alpha)$ is the fraction of firms setting prices optimally each quarter. α is set to 0.75 in Schmitt-Grohé and Uribe (2004).

We expected welfare to be increasing with price flexibility, that is, for a given χ (and $\tilde{\chi}$), welfare would be decreasing with α. Indeed $\alpha = 0$ means complete price flexibility. This seems to be the case by looking at Figure 4 that plots welfare as α and χ vary. The lower welfare level is by far given by the point ($\alpha = 1$,$\chi = 0$), as expected.

However, welfare is, surprisingly enough, *increasing in* α, for certain values of χ. That is: in certain part of the surface in Figure 4, the higher price stickiness, the higher welfare. Generally, this holds for quite high values of χ, as shown in Figure 5, and in particularly for $\chi = 0.88$ (see Figure 6).

Result 3 Given $\tilde{\chi} = 1$ and $\chi = 0.88$, steady state welfare is maximized for the maximum admissible level of price rigidity (i.e., $\alpha = 0.993$).[2]

Indeed, given $\tilde{\chi} = 1$, welfare is ever increasing in α for values of $\chi > 0.76$. Remarkably then, more price stickiness (i.e., higher values of α) can partially cure the monopolistic distortion, with substantial effects on steady state welfare.

4 Conclusions

This note shows that full price indexation is not optimal in the long-run in the New Keynesian model, because of monopolistic distortion. Note that the argument provided for the optimality of partial indexation is very different from the classical one in Gray (1976). Indeed, we are simply analyzing the steady state of a microfounded model, without considering any stochastic supply or demand shocks, that were instead crucial for Gray (1976) argument. Moreover, we show that more price stickiness may increase steady state welfare, if price indexation is partial.

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[2] Given positive steady state inflation and partial indexation, there is a maximum value for α, such that the first order condition for reset price is defined (see Ascari, 2004).

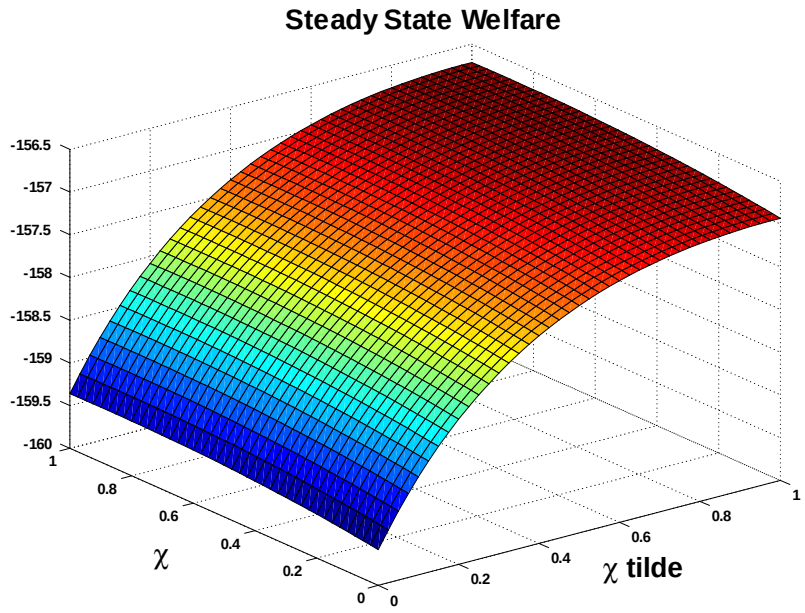

Figure 1

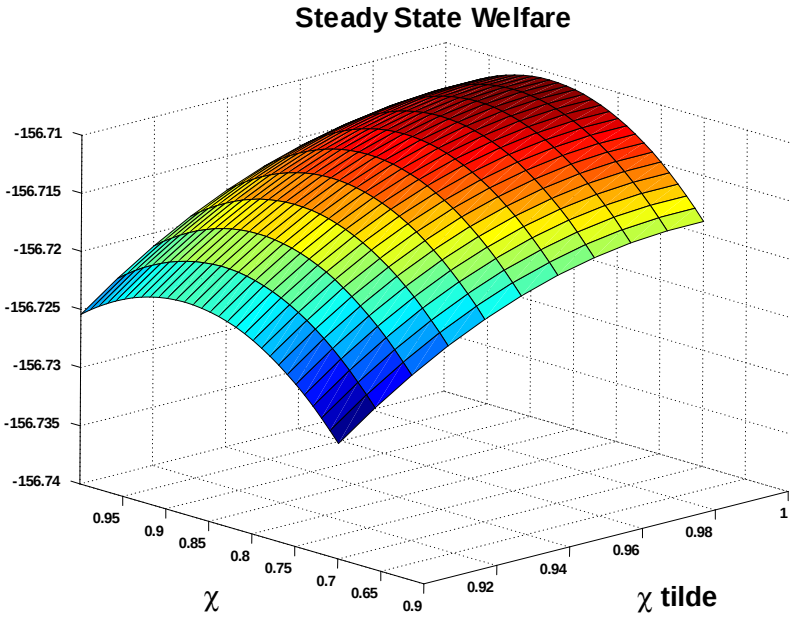

Figure 2

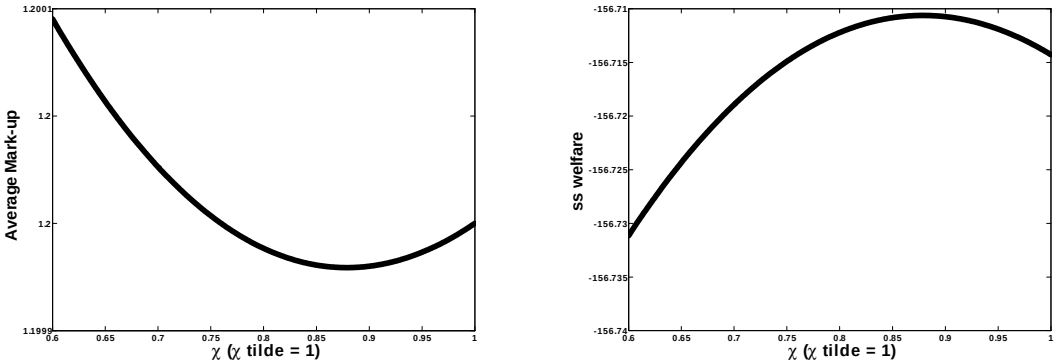

Figure 3

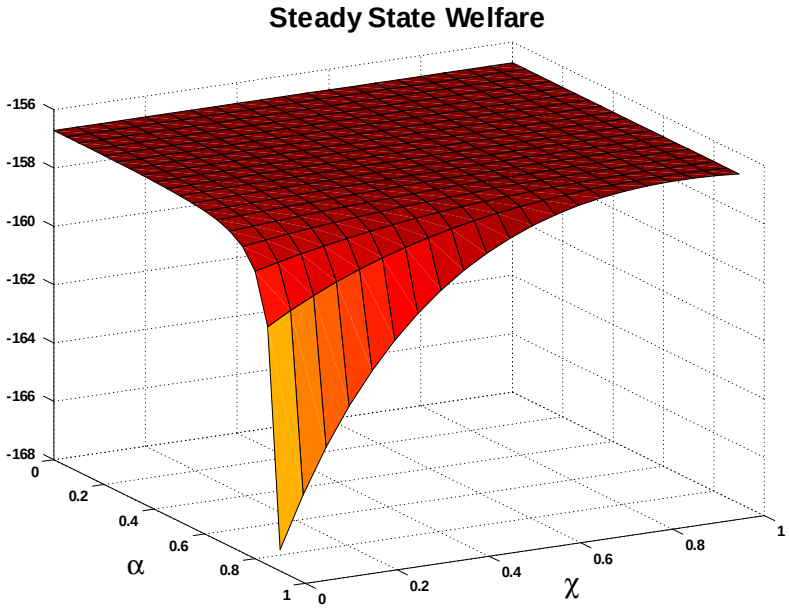

Figure 4

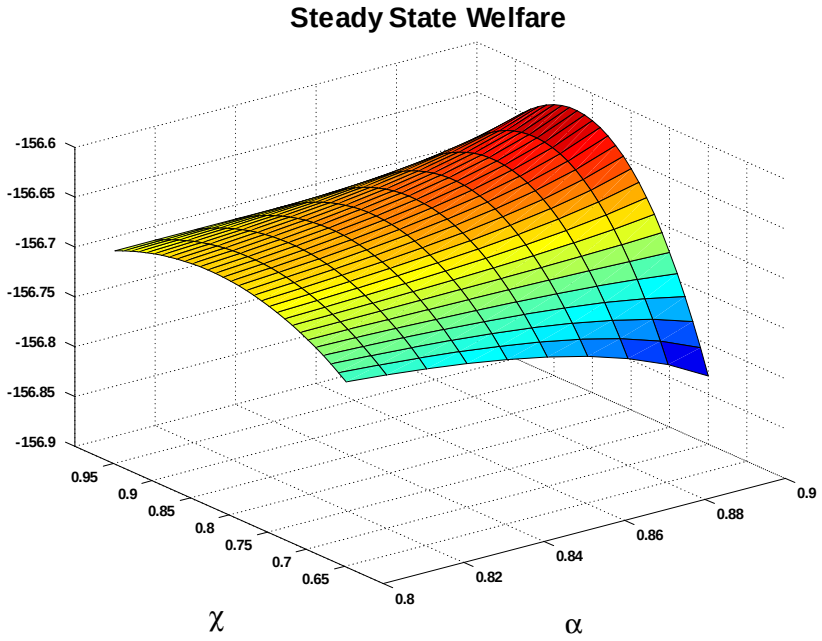

Figure 5

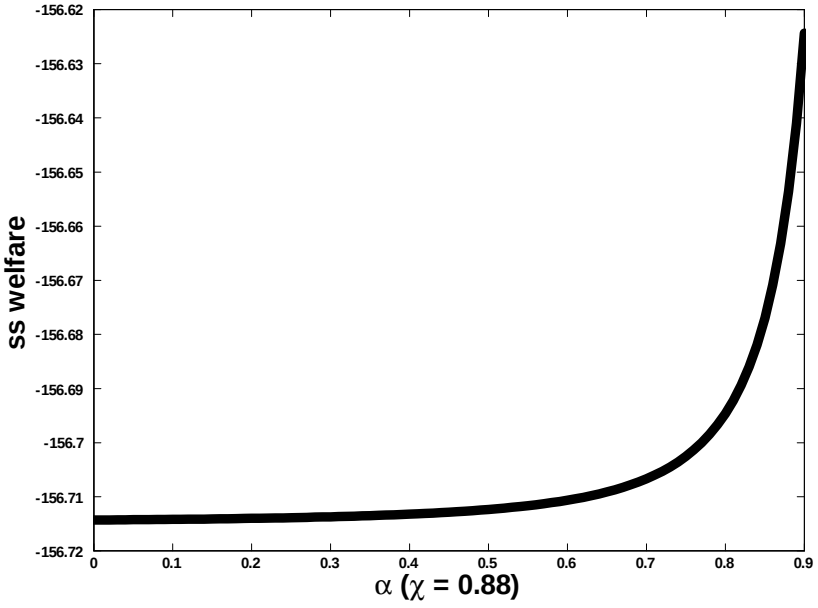

Figure 6