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### **Fair Behavior and Inflation Persistence**

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# Fair Behavior and Inflation Persistence

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## Abstract

In their seminal paper Fuhrer and Moore (1995) provide an explanation for the existence of inflation inertia. Driscoll and Holden (2003) argue that under more plausible assumptions the model of Fuhrer and Moore (1995) will coincide with the model of Taylor (1979) which can only explain sticky prices but not sticky inflation. Following the suggestions by Driscoll and Holden (2003) we extend their setting allowing for other-regarding preferences. It turns out that this new extended model is consistent with the one by Fuhrer and Moore (1995). This means that, even under the strong assumption of rational expectations, inflation is not only governed by its future expected but also by its past values. This is in line with empirical findings.

*Keywords: Inflation inertia, fairness, staggered contracts, inflation expectations, behavioral macroeconomics.*

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One of the challenges in macroeconomics still is to explain the tradeoff between inflation and unemployment. The model by Fuhrer and Moore (1995) is one which captures the data to a comparably high degree (Mankiw 2001). Especially, and in contrast to its predecessor models by Taylor (1980) and Calvo (1983), the Fuhrer-Moore-model is capable to reproduce inflation persistence instead of mere price inertia. Consequently, models of the Fuhrer-Moore-type are widely used in empirical macroeconomic research (e.g., Brayton and Tinsley (1996), Brayton et al. (1997), Coenen and Wieland (2005), Smets and Wouters (2003)).

Driscoll and Holden (2003), however, argue that the model by Fuhrer and Moore (1995) is theoretically not as plausible as it seems to be at first glance. According to them in an overlapping scheme wage setters should determine their nominal wages so that their expected future and current real wages are equal to those of other workers whose nominal wages are fixed in the present period. In contrast, Fuhrer and Moore (1995) argue to set current real wages equal to the average of other workers' real wages in the preceding and following period. Driscoll and Holden (2003) show that under their proposed modifications the Fuhrer-Moore model collapses to that of Taylor (1980) in which current inflation only depends on the expected future inflation and on the output gap. As their modified relative real wage contracting model does no more lead to inflation inertia Driscoll and Holden (2003) argue in favor of behavioral models which do not rely on full rationality and self-centeredness but informational restrictions (Roberts 1998, Ball 2000, Mankiw and Reis 2002) and fairness (Driscoll and Holden 2002).

Although we generally agree with Driscoll and Holden's (2003) critique on Fuhrer and Moore (1995) we pursue a diametral line in treating this issue. Instead of refusing Fuhrer and Moore's (1995) model as a sound quasi-microfoundation of inflation persistence we ask what subjects might have in mind when they follow the shortcut suggested by Fuhrer and Moore (1995). Speaking differently, in this note we do not ask whether their model is in line with standard microeconomic assumptions but we examine under which behavioral assumption macroeconomic results are received which turn out to be observably equivalent to those of Fuhrer and Moore (1995).

In Section I we briefly describe the model by Fuhrer and Moore (1995) and show how it is reduced to Taylor (1980) under the Driscoll and Holden (2003) modification. In Section II we structurally expand the Driscoll and Holden (2003) model in order to allow for subjects with other-regarding preferences. Both the expanded Driscoll and Holden (2003) and the Fuhrer and Moore (1995) setup are transformed to their basics, i.e. the contract wages, and

are compared by the method of undetermined coefficients (McCallum 1983). Finally, the results of this comparison are discussed.

### I. The Fuhrer and Moore model and the Driscoll and Holden critique

The model of Fuhrer and Moore (1995) bases on the assumption of overlapping wage contracts. Half of the wages are negotiated in each period and still will be valid in the following period. In that period the other half of the wages are set which in turn are valid for two periods.

Fuhrer and Moore (1995, p. 131) assume that in “... the relative wage specification ... agents compare the real value of their wage contracts with the real value of wage contracts previously negotiated and still in effect, and with contracts expected to be negotiated over the duration of the contract ...”. Additionally, current real wages are influenced by the size of the output gap<sup>3</sup>. These assumptions lead to the following real wage equation:

$$x_t - p_t = \frac{1}{2}(x_{t-1} - p_{t-1}) + \frac{1}{2}E_t(x_{t+1} - p_{t+1}) + ky_t \quad (1)$$

where  $x_t$  is the log deviation of the nominal contract wage,  $p_t$  the log deviation of the price level,  $y_t$  the log deviation of the output from equilibrium in period  $t$  and  $k > 0$  a constant parameter.

Firms set prices as a constant unit markup over wage costs. Therefore, current prices  $p_t$  are the average of the contract wages set in the previous and current period:

$$p_t = \frac{1}{2}(x_t + x_{t-1}) \quad (2)$$

Inserting (2) into (1), we obtain

$$\frac{1}{2}(x_t - x_{t-1}) = \frac{1}{4}(x_{t-1} - x_{t-2}) + \frac{1}{4}E_t(x_{t+1} - x_t) + ky_t \quad (3)$$

or

$$\Delta x_t = \frac{1}{2}\Delta x_{t-1} + \frac{1}{2}E_t\Delta x_{t+1} + 2ky_t \quad (3')$$

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<sup>3</sup> By relating current wage setting only to the current value of the output gap, we follow the general reception of Fuhrer and Moore (1995) in the literature (e.g., Roberts (1997), Walsh (2003), Driscoll and Holden (2003). Originally, Fuhrer and Moore (1995) also assumed an influence of the expected future output gap  $E_t y_{t+1}$  on current real wages  $x_t - p_t$ .

As  $\pi_t = p_t - p_{t-1} = \Delta p_t = \Delta x_t + \Delta x_{t-1}$ , current inflation is determined according to

$$\pi_t = \frac{1}{2} E_t \pi_{t+1} + \frac{1}{2} \pi_{t-1} + 2k(y_t + y_{t-1}) \quad (4)$$

Equation (4) shows that current inflation depends not only on the state of the business cycle and on expected inflation but also on its past values. This result is in stark contrast to earlier models of inflation dynamics (esp., Taylor 1980, Calvo 1983) which claim that inflation should not be driven by its lagged values.

Driscoll and Holden (2003) cast doubt on the plausibility of Fuhrer and Moore's (1995) microfoundation. In general, they agree with the idea of heading for on average equal real wages over the contract period. In particular, however, Driscoll and Holden (2003) question Fuhrer and Moore's (1995, p. 131) notion of the "real value of wage contracts previously negotiated and still in effect" formally represented by  $x_{t-1} - p_{t-1}$ . And indeed, for most economies where wages are negotiated in non-indexed nominal terms and prices are market results Driscoll and Holden's (2003) formal translation into  $x_{t-1} - p_t$  seems to be the more appropriate representation of the current real value of "... wage[s] ... still in effect ...". Unfortunately, neither Fuhrer and Moore (1995) nor Driscoll and Holden (2003) are very explicit on the legal framework of the labor market which would be the critical issue.

As we follow Driscoll and Holden's (2003) proposition to evaluate wages at the price level of the economically relevant but not the original contract period, we get (instead of equation (1)):

$$x_t - \frac{1}{2}(p_t + E_t p_{t+1}) = \frac{1}{2}(x_{t-1} - p_t) + \frac{1}{2} E_t (x_{t+1} - p_{t+1}) + ky_t \quad (5)$$

where the current real wage target on the LHS is related to other workers' expected real value wages during the contract period and the business cycle conditions, both shown on the RHS. As easily can be seen, the price levels in (5) cancel out and a overlapping nominal wage specification remains:

$$x_t = \frac{1}{2} x_{t-1} + \frac{1}{2} E_t x_{t+1} + ky_t \quad (6)$$

which was introduced to the literature by Taylor (1980). Consequently, the differentiation of (2) and its substitution by (6) leads to an inflation equation

$$\pi_t = E_t \pi_{t+1} + k(y_t + y_{t-1}) \quad (7)$$

already presented by Taylor (1980). Equation (7) predicts inflation not to be persistent (Fuhrer and Moore 1995).

## **II. The extension of Driscoll and Holden's (2003) idea**

Driscoll and Holden (2003) interpret the fact that their version of the relative real wage specification (in results) coincides with Taylor (1980) as evidence that the Fuhrer and Moore (1995) model has no potential to theoretically explain inflation inertia. As a consequence they refer in their conclusions to other attempts in the recent literature to reproduce inflation persistence. Whereas the major part of the mentioned work relies on cognitive (Roberts 1998, Ball 2000) and institutional (Mankiw and Reis 2002) restrictions of information processing, their own contribution to solve the problem has a very distinct starting point. In Driscoll and Holden (2002) inflation persistence is described as a consequence of a coordination problem which in turn is caused by workers' preferences for fair treatment.

In contrast to Driscoll and Holden (2003) we do not draw the conclusion to generally abandon Fuhrer and Moore (1995) as an explanation for inflation persistence. Instead, we follow the arguments of Driscoll and Holden (2003) in a literal way: We take their version of the real wage equation as a starting point and, in line with their suggestions, add a term which allows for fairness preference. Then, we rearrange the resulting new wage equation so that it can be compared to the one by Fuhrer and Moore (1995). For the comparison we apply the method of undetermined coefficients (McCallum 1983) in order to assess whether or in which range the model of Fuhrer and Moore (1995) is observably equivalent to our new model which is based on an undisputed microfoundation. In our opinion this course of actions, i.e., to challenge and not to abandon the Fuhrer and Moore (1995) model, is an appropriate way to cope with Driscoll and Holden's (2003) critique because the Fuhrer and Moore (1995) model seemed to be in line with researchers' conventional wisdom and empirical results for many years.

To represent other-regarding preferences in the wage equation we propose the reciprocity model of Falk and Fischbacher (2005). Although it originally focuses on another

topic, namely the role of intentions in context of fairness and reciprocity, it is helpful for our task. It is a tractable model that describes fair behavior at sequential points of time. This dimension of the model is of great importance as inflation by its nature is always a consequence of dynamic decision-making. Taking, for simplicity, intentions and other behavioral parameters as given and constant, Falk and Fischbacher (2005) tell us that individuals' fairness utility depends on current and past relative payoffs. We limit the influence of past relative payoffs to the previous period as this time horizon reflects the duration of wage contracts. Treating current relative wages as done in Driscoll and Holden's (2003) specification we receive a new real wage equation of the type:

$$x_t - \frac{1}{2}(p_t + E_t p_{t+1}) = \frac{1}{2}(x_{t-1} - p_t) + \frac{1}{2}E_t(x_{t+1} - p_{t+1}) + ky_t + \gamma[(x_{t-1} - p_{t-1}) - (x_{t-2} - p_{t-1})] \quad (8)$$

where  $\gamma > 0$  is the weight of the additional fairness term. Equation (8) states that, *ceteris paribus*, workers' real wage aspiration is higher the *relatively* higher other workers' real wages  $(x_{t-1} - p_{t-1})$  have been in the previous period, compared to own real wages  $(x_{t-2} - p_{t-1})$ . By doing so workers attempt to compensate last period's lack in fairness by a higher current wage that provides higher current and future payoffs in absolute as well as in relative terms.

Cancelling out the price levels and sorting contract wages and the output gap to different sides of the equation, we get:

$$ky_t = \frac{1}{2}(x_t - E_t x_{t+1}) + \frac{1}{2}(x_t - x_{t-1}) + \gamma(x_{t-2} - x_{t-1}) \quad (9)$$

or, more generally,

$$ky_t = \alpha(x_t - E_t x_{t+1}) + \beta(x_t - x_{t-1}) + \gamma(x_{t-2} - x_{t-1}) \quad (10)$$

Now, we can see that the new real wage specification linearly relates the current output gap  $y_t$  to a weighted average of the relative (nominal) wages in the current, previous, and next period. Furthermore, this general representation will turn out to be convenient for the reconciliation with its pendant associated with Fuhrer and Moore (1983).

If we take the sum of (10) and (10) lagged and double it, we receive<sup>4</sup>:

$$2k(y_t + y_{t-1}) = -2\alpha E_t x_{t+1} + 2\beta x_t + 2(\alpha - \gamma)x_{t-1} - 2\beta x_{t-2} + 2\gamma x_{t-3} \quad (10')$$

similar to equation (4). Substituting (2) in (4) (where  $\pi_t = p_t - p_{t-1}$ ), we get

$$2k(y_t + y_{t-1}) = -\frac{1}{4} E_t x_{t+1} + \frac{1}{2} x_t + 0 \cdot x_{t-1} - \frac{1}{2} x_{t-2} + \frac{1}{4} x_{t-3} \quad (11)$$

The comparison of the coefficients of (10') and (11) delivers five conditions:

$$-2\alpha = -\frac{1}{4} \Leftrightarrow \alpha = \frac{1}{8} \quad (12.1)$$

$$2\beta = \frac{1}{2} \Leftrightarrow \beta = \frac{1}{4} \quad (12.2)$$

$$2(\alpha - \gamma) = 0 \Leftrightarrow \alpha = \gamma \quad (12.3)$$

$$-2\beta = -\frac{1}{2} \Leftrightarrow \beta = \frac{1}{4} \quad (12.4)$$

$$2\gamma = \frac{1}{4} \Leftrightarrow \gamma = \frac{1}{8} \quad (12.5)$$

As the requirements of (12.1), (12.5), and (12.3) as well as of (12.2) and (12.4) are consistent to each other, a single solution is obtained:  $\alpha = \frac{1}{8}$ ;  $\beta = \frac{1}{4}$ ;  $\gamma = \frac{1}{8}$ . The existence of this solution means that the inflation dynamics predicted by Fuhrer and Moore (1995) is observably equivalent to the one of our proposed economy with overlapping wage contracts, markup pricing, and a wage setting behavior according to

$$ky_t = \frac{1}{8}(x_t - E_t x_{t+1}) + \frac{1}{4}(x_t - x_{t-1}) + \frac{1}{8}(x_{t-2} - x_{t-1}) \quad (13)$$

In other words, wage setters of the Fuhrer and Moore (1983) type might be thought as relating past, present and future *relative* wages to the current output gap, ascribing double weight to the present period's wages.

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<sup>4</sup> For simplicity, we drop the expectational error  $\eta = E_{t-1} x_t - x_t$ .

Solving (13) for  $x_t$  and evaluating nominal wages by the respective price level leads to the type of representation which is already known from Driscoll and Holden (2003) (equation 5):

$$x_t - \frac{2}{3} p_t - \frac{1}{3} E_t p_{t+1} = \frac{2}{3} (x_{t-1} - p_t) + \frac{1}{3} E_t (x_{t+1} - p_{t+1}) + \frac{8}{3} k y_t + \frac{1}{3} [(x_{t-1} - p_{t-1}) - (x_{t-2} - p_{t-1})] \quad (8'),$$

In contrast to Driscoll and Holden (2003), the wage setters described by equation (8') also care for fairness in the previous period, they react more sensitively to the output gap, and, in general, ascribe a higher weight to present period outcomes.

### III. Discussion and conclusions

We have derived and shown in which way wage setters behave in an economy which is characterized by overlapping contracts in the labor market and persistent inflation in the goods market: Workers currently in charge to negotiate their wages try to set their nominal wages so that for the contract period the weighted average of their real wages (LHS of 8') is equal to that of the other, fixed workers, corrected by the current business cycle conditions and the degree of fairness of last period outcomes (RHS of 8'). In other words, this is what workers might really have in mind or what might be the unconscious determinants when a wage setting heuristic of the Fuhrer and Moore (1995) type is applied.

Furthermore, the concrete coefficients turn out to be plausible to many respect: First, it seems to be a successful strategy for the wage setters to attach more importance to the current ( $\beta$ ) than to the future period ( $\alpha$ ). As real economies are subject to stochastic shocks and, consequently, future developments are hard to predict forecasting and related wage setting errors might have strong negative consequences (such as unemployment). Insofar, a concentration on the current value of others' wages is an appropriate strategy. Secondly, a stronger weight on the present period is also in line with the phenomenon of time preference which is not explicitly modelled in this class of simple macro-models. Thirdly, a limited effect of the fair or unfair character of last period outcome ( $\gamma$ ) reflects the rationale that the utility inferred from other subjects' payoffs never should overweight that of own material benefits. Furthermore, a minor weight on past fairness might be explained by the fact that the other workers have not been entirely free in setting wages in the previous period as their decision was conditioned on the then output gap (Kahneman, Knetsch, and Thaler 1986). Insofar, a fair or unfair outcome might be considered as partially unintended (Falk and Fischbacher 2005).

Of course, proving that the new wage equation is consistent with Fuhrer and Moore's (1995) outcome provides the fairness motive only as a potential explanation for inflation persistence. Other foundations of inflation persistence such as adaptive expectations (Roberts 1997, 1998; Ball 2000), sticky informations (Mankiw and Reis 2002), and habit formations (Fuhrer 2000, Amato and Laubach 2003) are still reasonable alternative. Which deviation of the purely neoclassical assumptions or which even bundle of deviations finally will prove to be causal for inflation inertia is up to further research. For now and from a macroeconomic perspective, the Fuhrer and Moore (1995) model can be behaviorally justified.

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