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Doves, Hawks and Pigeons: Behavioral Monetary Policy and Interest Rate Inertia

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DOVES, HAWKS AND PIGEONS:
BEHAVIORAL MONETARY POLICY AND INTEREST RATE INERTIA

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Behavioral bias – loss aversion – can explain monetary policy inertia in setting interest rates. Economic literature has tended to explain inertia in monetary policymaking in terms of frictions and delays, or has stressed the role of governance rules. We introduce a new driver of inertia, independent from frictions and central bank governance settings: a Monetary Policy Committee (MPC) that takes decisions on interest rates by voting according to a majority rule, in an economy with nominal price rigidities and rational expectations. Central bankers are senior officials, high-ranking bureaucrats who care about their careers and can be divided into three groups, depending on their level of inflation conservatism: doves, pigeons, and hawks. While a conservative stance doesn't necessarily produce monetary inertia, we show that introducing loss aversion in individual behavior influences the stance of monetary policy under three different but convergent perspectives. First of all, a *Moderation Effect* can emerge, i.e. the number of pigeons increases. At the same time also a *Hysteresis Effect* can become relevant, whereby both doves and hawks soften their attitudes. Finally a *Smoothing Effect* tends to stabilize the number of pigeons. Together, the three effects consistently cause higher monetary policy inertia.

KEYWORDS: MONETARY POLICY, BEHAVIORAL ECONOMICS

JEL Classification: E5

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1. INTRODUCTION

In the aftermath of the severest recession since the Second World War, the Federal Reserve (Fed) faces extraordinary challenges in designing and implementing monetary policy. The overall result has been massive monetary accommodation with interest rates close to zero, coupled with an exceptional expansion of the Fed's balance sheet. The so called Great Recession ended in June 2009, but seven years afterwards, the Fed is still delaying the process of going back to normal. Expansionary monetary policy has been implemented long after the recession ended, raising questions on the drivers and consequences of monetary inertia, i.e. in this case reluctance in leaving the ultra-expansionary monetary status quo to start a policy of interest rate normalization[1].

But the discussion over the (delayed) lift-off in US monetary policy is just the latest episode in long-lasting debate: how inertia in monetary policy can be explained? In the last two decades in several cases central banks have showed reluctance in leaving the monetary status quo, raising questions on the rationale that can justify such stance. As it has been insightfully pointed out[2] at least in the case of the US monetary policy, a period of monetary inertia after the end of a recession is not uncommon. At the same time, cases of monetary inertia have been registered for some time after the end of an expansion; further this inertial feature of central bank behavior has been especially noted in the case of the Fed, but it characterized many other central banks[3] .

So far the economic literature offered two different explanations: information inertia and governance inertia.

Originally, monetary inertia was motivated by observing that the central bank decisions depend on information on the state of the economy, as well as on the recognition of the long and variable lags in the transmission of monetary policy. Therefore monetary inertia can be considered a rational strategy in order to avoid tough stop-and-go policies and their consequences in terms of negative macroeconomic spillovers. The tendency of central banks to adjust interest rates only gradually in response to changes in economic conditions can thus be considered optimal[4]. More recently optimal monetary policy has been derived by departing from the rational expectations hypothesis, i.e. by assuming that individual agents follow adaptive learning[5].

Under a different perspective, the case of monetary policy inertia has been analyzed by exploring the role of central bank governance. On this respect two studies focusing on Monetary Policy Committees (MPCs) seem particularly interesting: Dal Bo (2006), and Riboni and Ruge-Murcia (2010).

Dal Bo (2006) shows that the voting procedure requiring a supermajority - i.e. a so called consensus setting - leads the MPC to behave as a conservative central banker *à la* Rogoff (1985). The

1 Orphanides 2015.
2 Orphanides 2015.
3 Goodhart 1996 and 1998, Woodford 1999.
4 Woodford 1999, Driffil and Rotondi 2007, Consolo and Favero 2009.
5 Molnar and Santoro 2014.

supermajority rule mitigates issues of time-inconsistency and introduces a status-quo bias in monetary policy decisions.

Riboni and Ruge-Murcia (2010) analyze four different framework in the central banking governance, comparing the simple majority (median voter) model, the consensus model, the agenda setting model (where the chairman controls the board agenda), and the dictator model (case of influential chairman).

While the simple majority model and the dictator model are observationally equivalent to a one-man central bank, the consensus model and the agenda setting model are different, creating something like a persistent status-quo monetary policy. In the first two models the MPC adjusts the interest rate taking into account the value preferred by the key members - respectively the median voter and the chairman - regardless of the initial status-quo. In the other two models the MPC can keep the interest rate unchanged in the so called inaction region, i.e. monetary inertia can occur. Further the agenda setting model predicts larger interest rate increases than the consensus model, when the chairman is more hawkish than the median member. In other words, inertia in the interest rate decisions can be associated with features of central bank governance (*governance inertia*).

More generally the exploration of the nexus between individual behaviors and policy inertia can shed lights also on the relevance of the overall governance setting in shaping monetary policy actions and their results. From an institutional point of view, in the last three decades central banks around the world were granted increasing degrees of political and functional independence to encourage long sighted monetary policy, protecting the central bankers from short-term political bias. The economic rationale is well-known, and the theoretical bottom line can be summarized as follows (Masciandaro 1995, Ejffinger and Masciandaro 2014): policymakers tend to use monetary tools with a short sight perspective, using the inflation tax to smooth out various kinds of macroeconomic shocks – i.e. real (Barro and Gordon, 1983) and fiscal (Sargent and Wallace, 1981) unbalances - trying to exploit the trade-off between real gains and nominal (inflationary) costs.

The inflation tax finances stabilization policies. But the more markets are efficient the greater the risk that short sighted monetary policy just produce just inflation. In fact rational private agents fully anticipate the political incentives to use the inflation tax, fully adjusting nominal variables. In this framework the Friedman–Lucas proposition on monetary policy neutrality holds.

Furthermore, the political inflation bias can dynamically generates greater uncertainty and negative externalities (such as moral hazard risks). The inflation tax is inefficiently used in a systematic way, becoming tendentially high and volatile and then producing only macroeconomic distortions. The inefficient use of the inflation tax was empirically confirmed by the fact that optimal taxation theory did not find any support in the data.

Therefore, banning the use of the monetary policy for inflation tax purposes becomes the social goal. The institutional setting gains momentum; the relationship (governance) between the policymaker – who designs the overall economic policy framework - and the central bank - which is responsible for the monetary policy – becomes crucial in avoiding the inflation bias. The more markets are rational, the more the rules of the game between policymakers and central bankers gain momentum (Barro and Gordon, 1983; Backus and Driffill, 1985; Rogoff, 1985; Lohmann, 1992).

Optimal central bank governance is essentially a two-sided coin. On the one side, the central banker has to be independent, i.e. the central bank must enjoy the ability to implement a non-inflationary monetary policy without any external (political) short sighted interference (Grilli et al. 1991, Cukierman et al. 1992). The central banker becomes a veto player against inflationary monetary policies. On the other side, the central banker has to be conservative, where conservativeness refers to the importance that he/she assigns to price stability in relation to other macroeconomic objectives. Conservativeness is a necessary step to avoid that the central banker himself/herself becomes a source of inflation bias. Independence and conservativeness become the conditions to implement credible non-inflationary monetary policies.

Therefore central bank governance has become the institutional setting for implementing the day by day monetary policy: given the long run goal to avoid the risk of inflation, the modern central banker can also smooth out real business cycles (Bernanke and Gertler, 1995; Clarida, Gali and Gertler, 1999; Woodford, 2003), using monetary policy rules (Taylor, 1993; Walsh, 1995). Monetary policy becomes the final outcome of a complex interaction between three main components: monetary institutions, central banker preferences and policy rules (Persson and Tabellini, 1993; Svensson, 1995).

Here the behavioral biases can step in. How the relationships between institutional setting, central bank preferences and monetary policy outcomes can be modified if we assume that psychological drivers can influence the decisions of the central bankers? Such a question can become even more interesting, at a moment when, due to the effect of the 2008 Crisis, the evolution of the central banking governance is in a state of flux (Masciandaro and Romelli 2015).

The paper is organized as follows. Section 2 presents the basic model: an economy with nominal rigidities and rational expectations where an independent central bank sets monetary policy, and interest rate inertia can occur due to informational friction.

Section 3 introduces sequentially the assumptions that each central banker is a high-ranking bureaucrat – i.e. a career concerned agent - with his/her conservativeness, that a Monetary Policy Committee (MPC) formulates monetary policy decisions voting with a simple majority rule, and finally that loss aversion characterizes the behavior of the central bankers – i.e. for every monetary policy choice, losses loom larger than gains, and both are evaluated with respect to the *status quo*. The modified model shows that, given three types of central bankers (doves, pigeons, hawks) the introduction of loss aversion in individual behavior influences the monetary policy stance under two different but convergent points of view. First of all a *Moderation Effect* can emerge, i.e. the number of pigeons increases. At the same time also a *Hysteresis Effect* can become relevant: both doves and hawks soften their stances. Finally a *Smoothing Effect* tends to stabilize then number of pigeons. The three effects consistently trigger higher interest rate inertia, which is independent from both the existence of frictions and the absence or presence of certain features of central bank governance. Section 4 concludes.

2. MONETARY POLICY INERTIA: THE BASIC MODEL

As we already stressed in the previous section so far the economic literature explored two cases of monetary inertia: informational inertia and governance inertia. Here we analyze an economy with nominal price rigidities and rational expectations, where a Monetary Policy Committee (MPC) takes decisions on the interest rates using a majority rule. The members of the MPC – i.e. the central bankers – are high-level officials that care about their careers and can be splitted in three groups, depending on their monetary conservativeness: doves, pigeons and hawks.

In the monetary policy literature a specific jargon has been coined: a "dove" is a policymaker that likes to implement active monetary policies, including inflationary ones, while a "hawk" is a policymaker that dislikes them (Chappell et al. 1993, Jung 2013, Jung and Kiss 2012, Jung and Latsos 2014, Eijjfinger et al. 2013a and 2013b, Neuenkirch and Neumeier 2013, Wilson 2014, Eijffinger et al. 2015). Pigeons fall in the middle. Throughout time, the dovish/hawkish attitude has probably become one of the main focus of the analysis of monetary policy board decisions.

We will show how the introduction of loss aversion in individual behavior influences monetary policy decisions.

2.1. Optimal monetary policy and conservativeness

We start from a basic monetary policy framework with nominal price rigidities[6] . In this model, aggregate equations reflect the optimization by households and firms, which in turn depends on expectations, and monetary policy has an effect on the real economy.

Letting y_t and z_t be respectively the logs of the stochastic component, the natural level of output and the output gap x_t will be $x_t \equiv y_t - z_t$ while π_t is the period inflation rate and i_t the nominal interest rate. We have an aggregate supply curve that is positively correlated with inflation and an output gap that is coupled with an aggregate demand curve, where the output gap is inversely associated with the real interest rate:

$$\pi_t = \lambda x_t + \beta\left[E_t \pi_{t+1}\right] + u_t \qquad (1)$$

$$x_t = E_t x_{t+1} - \varphi\left[i_t - E_t \pi_{t+1}\right] + g_t \qquad (2)$$

Where u_t and g_t are standard disturbance terms that behave as follows:

$$u_t = \rho u_{t-1} + \hat{u}_t$$

$$g_t = \mu g_{t-1} + \hat{g}_t$$

Where $0 \leq \rho\mu \leq 1$ and $\hat{u}, \hat{g}$ are random variables with zero mean and finite variance.

6 Clarida et al. 1999.

As usual, to the extent that monetary policy affects the short term real interest rate, in a setting with nominal rigidities the actions of the central bank can have real effects.

The central bank goal function targets the macroeconomic key variables x_t and π_t having as usual as bliss objectives the natural level of output and zero inflation –without any loss of generality - therefore assuming the standard form:

$$U_{cb} = \max - \frac{1}{2} E_t \left[\sum_{i=1}^{\infty} \beta^{i} \left(\delta \alpha x_{t+i}^2 + \pi_{t+i}^2 \right) \right] \qquad (3)$$

Where the parameter α is the relative weight of the two macroeconomic goals. At the same time the parameter $0 < \delta \leq 1$ captures in the simplest way the explicit role of central bank independence. Following the approach introduced in Eijffinger and Hoeberichts (1998) we modified the standard time inconsistency model in order to capture the legal relationships between the central bank and the politicians: the more the central bank is isolated from the short sighted political pressures – i.e. higher independence – the less there will be distortions in the weighting of macroeconomic goals. Being interested in zooming on the drivers of monetary policy different from the institutional setting, we will assume that $\delta = 1$, i.e. the degree of central bank independence is the maximum one. We assume that an independent central bank can set the monetary policy consistently with its preferences, i.e. the legal mandate is associated with sufficient discretion in defining the monetary policy strategy.

Assuming now discretion in monetary policy actions and rational expectations, in each period the solution of the optimization problem produces the following optimality condition:

$$\pi_t = -\frac{\alpha}{\lambda} x_t \qquad (4)$$

Condition (4) helps automatically identify the optimal monetary policy: when inflation is above the target, the central bank has to implement a restrictive policy monetary; the opposite is true when inflation is below target. The toughness of the central bank reaction depends on the sacrifice ratio λ between gains in inflation control versus costs in term of output losses, as well as on the how dovish the central bank is α, i.e. how important is output stabilization with respect to inflation stabilization. It is worth remembering that dovishness is the opposite of inflation conservatism (hawkishness), which we indicate using the parameter $t = \frac{1}{\alpha}$.

Finally, assuming that the monetary policy instrument is the interest rate i_t the formulation of the optimal policy i_t will be equal to:

$$i_t^* = \gamma_\pi \rho \pi_t + \frac{1}{\varphi} g_t \qquad (5)$$

Where:

$$\gamma_\pi = 1 + \frac{(1-\rho)\lambda}{\rho\varphi\alpha} > 1 \qquad (6)$$

. In equilibrium with rational expectations a relationship between inflation and conservativeness is likely to emerge. The optimal rate of inflation is equal to:

$$\pi_t = \frac{\alpha u_t}{\lambda^2 + \alpha(1-\beta\rho)} \qquad (7)$$

Equation (7) shows the well-known result that in a basic macro setting the optimal policy incorporates inflation targeting, as well as the central bank conservativeness. Given the macroeconomic features of the economy – i.e. the values of λ, ρ, μ - uncertainty and time discount, the crucial driver will be the degree of conservativeness, i.e. less concern for output losses implies a more rapid convergence of inflation to its target over time, and vice versa.

Inflation and central bank conservativeness are inversely correlated, which is immediately evident when disturbances are completely random – i.e. $\rho, \mu = 0$ [7]:

$$\frac{\partial\pi}{\partial\alpha} = \frac{\lambda^2 u_t}{\lambda^4 + 2\alpha\lambda^2 + \alpha^3} > 0 \qquad (8)$$

Which implies:

$$\frac{\partial\pi}{\partial t} = -\frac{\lambda^2 u_t}{\lambda^4 t^2 + 2\lambda^2 t + 1} < 0 \qquad (9)$$

It is interesting to note that also the sensibility of the interest rate – i.e. the value of parameter γ - depends on conservativeness, given that:

$$\frac{\partial\gamma}{\partial t} = \frac{\lambda(1-\rho)}{\varphi\rho} > 0 \qquad (10)$$

Putting together conditions (9) and (10), it is evident that changes in the degree of central bank conservativeness don't imply an automatic effect in terms of interest rate dynamics: a more conservative central banker likes lower level of inflation, but at the same time she becomes more sensible with respect to inflation changes. The two effects push the interest rate in opposite directions and the final outcome has to be defined from time to time; in fact:

$$\frac{\partial i}{\partial t} = \left[\frac{u\left(\lambda + \beta\lambda\rho^2 - ((1+\beta\lambda) + \varphi\lambda^2\right)}{\varphi\lambda^4 t^2 + (2\varphi\lambda^2 - 2\beta\phi\lambda^2)t + \beta^2\varphi\rho^2 - 2\beta\varphi\rho + \varphi}\right] \qquad (11)$$

At the end of the day, the optimal interest rate policy will depend on the structural features of the economy.

[7] In the general case the inverse association is between inflation volatility and conservativeness; see Clarida et al. 1999.

2.2 Interest Rate Rule and Inertia

The existing economic literature points out that in the basic monetary policy model that we described in the previous paragraph, monetary inertia can occur due to the existence of frictions and delays. Overall inertia in policy may reflect the inertia in the economy itself. Traditionally it has been observed the fact that changes in macroeconomic conditions trigger changes in the interest rate, but these changes occur via a series of small and lagged adjustments, rather than an immediate, abrupt and once and for all movement. In other words the past level of the nominal interest rate appears to be a crucial driver of the current level of the interest rate[8]; we can capture this standard result in the simplest way:

$$i_t^* = \xi i_{t-1} + \gamma_\pi \rho \pi_t + \frac{1}{\varphi} g_t \qquad (13)$$

Where the coefficient $0 < \xi < 1$ measures the degree of inertia in the central bank reaction function. The inertial coefficient can explain the fact that in some cases discrete interest rate changes are more likely to be followed by another change of the same sign than by a change in the opposite sign[9].

3. MONETARY POLICY INERTIA: THE BEHAVIORAL MODEL

3.1 Central Banker as a Bureaucrat and Inflation Conservatism

Now we assume that the society has decided to assign the monetary policy task to a bureaucrat, i.e. a career-motivated player that chooses the policy action entailing personal benefits and costs, being preferable to politicians in performing a technical task such as the conduct of monetary policy[10].

Therefore let $V(t,\pi)$ be the personal utility function of the central banker:

$$V(t,\pi) = B(t,\pi) - C(t,\pi) \qquad (14)$$

Where $B(t,\pi)$ and $C(t,\pi)$ are respectively the individual benefits and costs[11].

First of all we know from (3) that, from an institutional point of view, inflation can be a beneficial tool for macro stabilization. On top of that it is worth noting that, being the central banker a bureaucrat, inflation can be considered a financial source for her organization.

In fact given a basic central bank balance sheet constraint[12], we know that, when d is the real dividend the central bank paid to the State, h is the flow of currency and θ the nominal expenses of running the central bank, the central bank income is increasing with inflation:

$$d + \pi = h + \theta \qquad (15)$$

8 Woodford 1999.
9 Rudebush 1985.
10 Alesina and Tabellini 2007, Dalla Pellegrina and Masciandaro 2008, Masciandaro 2009.
11 Alesina and Passarelli 2013.
12 Reis 2015.

Therefore at least for two different and consistent reasons we can assume that the individual benefits are increasing and concave in the inflation rate:

$$\frac{\partial B(t,\pi)}{\partial \pi} > 0 \quad \frac{\partial B^2(t,\pi)}{\partial \pi} < 0 \tag{16}$$

At the same time again from (3) we know that inflation is costly for the central bank as an institution, so we can assume that individual costs are increasing and convex:

$$\frac{\partial C(t,\pi)}{\partial \pi} > 0 \quad \frac{\partial C^2(t,\pi)}{\partial \pi} \geq 0 \tag{17}$$

Further we assume that central bankers are heterogeneous with respect to their degree of conservativeness; central bankers can be indexed such that more conservative central bankers bear higher marginal costs and/or enjoy lower marginal benefits from the policy, given that obviously for a conservative central banker the implementation of an inflationary policy is costly:

$$\frac{\partial B(t,\pi)}{\partial \pi} \leq 0 \, ; \, \frac{\partial C(t,\pi)}{\partial \pi} \geq 0 \tag{18}$$

The equilibrium is interior, i.e. we exclude that a deflationary equilibrium can be optimal:

$$\frac{\partial B(t,0)}{\partial \pi} > \frac{\vartheta C(t,0)}{\partial \pi} \tag{19}$$

Therefore in equilibrium the central banker's optimal inflation rate , π_{cb} is such that marginal benefits match marginal costs:

$$\frac{\partial B(t,\pi_{cb})}{\partial \pi} = \frac{\vartheta C(t,\pi_{cb})}{\partial \pi}$$

And that:

$$\frac{\partial \pi_{cb}}{\partial t} < 0 \tag{20}$$

Which is exactly the condition (9) that holds in equilibrium in our macroeconomic system with nominal stickiness and rational expectations: inflation and conservativeness are inversely associated.

3.2. Central Bankers, Monetary Policy Committee and Choices

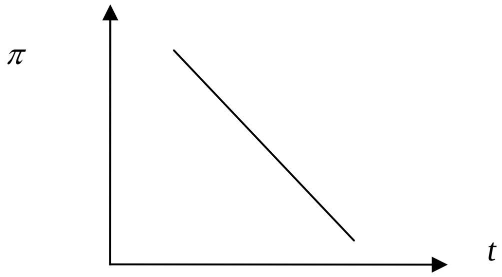
Finally we assume that a Monetary Policy Committee (MPC) with N members formulatesmonetary policy decisions. The central bankers, which are the members of the Committee, are individuals (voters), heterogeneous in the parameter t. We assume that:

a) Each MPC member maximizes her own goal function (14);

b) Each MPC member chooses the preferred inflation rate π and consistently with rule (5) the optimal interest rate i, without any inertia;

c) The MPC members vote using a majority rule: therefore the monetary policy outcome is the median type's optimal inflation rate π_m and optimal interest rate i_m. The optimal inflation rate will be inversely correlated with the conservativeness of the median central banker t_m (Figure 1):

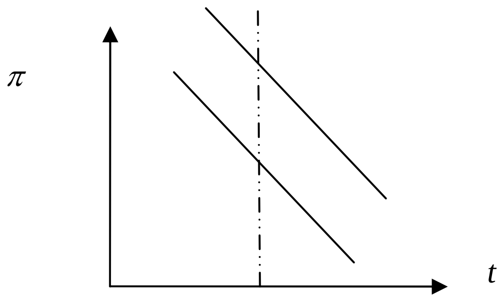
FIGURE 1



It is worth noting that:

i) Given equation (7), any change in the macroeconomic structure will modify the optimal inflation rate, given the central bank's conservativeness; for example, a more convenient ratio between output gains and inflation losses – i.e. a change in the sacrifice ratio – will increase inflation (Figure 2):

FIGURE 2



which is as usual immediately evident when the disturbances are completely random – i.e. $\rho, \mu = 0$:

$$\frac{\partial \pi}{\partial \lambda} = -\frac{2\alpha\lambda u_t}{\lambda^4 + 2\alpha\lambda^2 + \alpha^2} < 0 \qquad (21)$$

ii) the median type's policies are not necessarily coincident with social optimal ones. The social planner would optimize the sum of the preferences of individual central bankers:

$$\int [B(t,\pi) - C(t,p)] dF(t) \qquad (22)$$

Where socially optimal inflation π_s and the consistent interest rate policy i_s is the policy that equalizes the average marginal benefits $B_s(\pi)$ with the average marginal costs $C_s(\pi)$:

$$B_s(\pi) = C_s(\pi) \qquad (23)$$

And therefore in general it will be true that:

$\pi_m \neq \pi_s$ and $i_m \neq i_s$, and $t_m \neq t_s$, (24)

i.e. the conservativeness of the median central banker is not necessarily equal to that of the average central banker.

ii) We assume constant voting rules, in order to shed light on monetary inertia independently from how the MPC governance is designed.

3.3 Central Bank Governance and inertia

From Riboni and Ruge-Murcia (2010) we know that with the median central banker model, regardless of the initial status quo, the MPC will adopt the interest rate preferred by the median voter. In other words, the central bank's governance is frictionless in the sense that the status quo doesn't matter in determining the actual interest rate i_m

In order to have monetary policy inertia, we have to assume a different governance setting, where the relevant degree of conservativeness differs from the median one. A sufficient condition is to assume a consensus model, i.e. a setting where a super-majority is needed to set the interest rate. If N is the number of the MPC members, let $\frac{(N+1)}{2}+k$ be the size of the smallest super-majority required to set the equilibrium interest rate i_{SM} where $i_{SM} = i_m iff k = 0$. Therefore monetary policy inertia – i.e. a significant autocorrelation coefficient $\varsigma > 0$ in the interest rate path – is more likely to occur in a super majority model, the greater the level of consensus required to change the interest rate, i.e. $k \rightarrow \frac{(N-1)}{2}$:

$$i^*_{m,t} = \xi i_{m,t-1} + \gamma_\pi \rho \pi_t + \frac{1}{\varphi} g_t \qquad (25)$$

3.4. Optimal Monetary Policy: Loss Aversion and Central Banker Types

Now we assume that with loss aversion, and for every monetary policy choice, losses loom larger than gains, and both are evaluated with respect to the *status quo*. Let $z > 0$ be the parameter which captures loss aversion and let π^s be status quo inflation. Increasing inflation - $\pi > \pi^s$ - entails more benefits than costs, but higher inflation costs yield psychological losses which amount to:

$$z(C(t_i,\pi)-C(t_i,\pi^s)) \qquad (26)$$

In other words loss adverse central bankers overestimate inflation distortions. Vice versa reducing the inflation rate - $\pi < \pi^s$ - entails less benefits than costs, but with psychological losses which amount to:

$$z(B(t_i,\pi)-B(t_i,\pi^s)) \qquad (27)$$

Here the loss adverse central banks overestimate seigniorage losses as well as decreasing macro stabilization capacities. Therefore the central banker goal function with loss aversion $V(t_i,\pi/\pi^s)$ is given by standard utility $V(t_i,\pi)$ minus the psychological losses due to the departures from the status quo:

$$V(t_i\pi/\pi^s)=V(t_i,\pi)-z(C(t_i,\pi)-C(t_i,\pi^s)) if \pi > \pi^s$$

$$V(t_i\pi/\pi^s)=V(t_i,\pi)-z(B(t_i,\pi)-B(t_i,\pi^s)) if \pi < \pi^s$$

The optimal conditions are as follows:

$$B(t_i,\pi)=(1+z)C(t_i,\pi^s) if \pi > \pi^s \qquad (28)$$

$$(1+z)B(t_i,\pi)=C(t_i,\pi^s) if \pi < \pi^s \qquad (29)$$

Now, given the status quo inflation π^s, the dovish central banker will be characterized by a level of conservativeness $\overset{d}{t}$,such that:

$$B(t_i,\pi^s)=(1+z)C(t_i,\pi^s) \qquad (30)$$

While the hawk (conservative) central banker will be characterized by a level of conservativeness $\overset{h}{t}$,such that:

$$(1+z)B(t_i,\pi^s)=C(t_i,\pi^s) \qquad (31)$$

Where $\overset{d}{t} < \overset{h}{t}$

Therefore, for each central banker it will be true that, given her level of conservativeness t_i , she will set her preferred inflation target π_i according to the following rule:

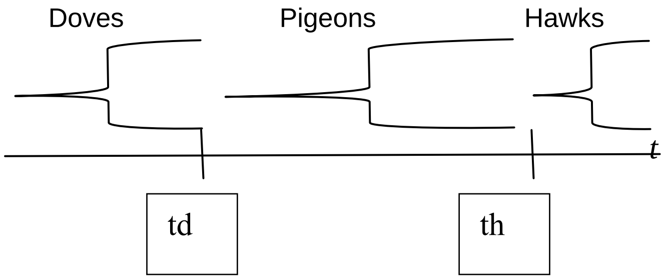
$$B(t_i,\pi)=(1+z)C(t_i,\pi^s) if t_i < \overset{d}{t}$$

$$(1+z)B(t_i,\pi)=C(t_i,\pi^s) if t_i > \overset{h}{t} \qquad (32)$$

$$\pi = \pi^s if\ t^d < t < t^h$$

Therefore every MPC can be divided into in three different groups: doves - $if t_i < t^d$ - hawks - $if t_i > t^h$ and pigeons - $if\ t^d < t < t^h$ (Figure 3).

FIGURE 3



And each MPC member expresses well defined inflation and interest rate preferences. With respect to the standard situation we are assuming that i) each central banker will evaluate any policy in terms of changes from the monetary policy status quo; ii) any negative effect of a change with respect to the status quo are thought to loom larger than a positive effect of equivalent magnitude. The two assumptions are a simple application of the loss aversion principle (Kahneman and Tversky 1979, Tversky and Kahneman 1991), highlighting the fact that if there is a loss/gain asymmetry for central bankers, monetary inertia is more likely to occur, as we will see in the next section.

3.5 The Status Quo Bias in the Monetary Policy Choices: When the Pigeons Win

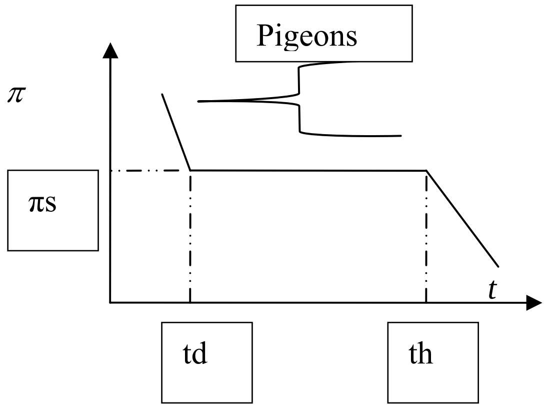
We already know that the MPC chooses the monetary policy strategy using a majority rule and that the consequent outcome is the median type's optimal inflation rate π_m and optimal interest rate i_m Therefore the optimal inflation rate will depend on median conservativeness t_m , having three possibilities: dove, pigeon and hawk. More precisely three different equilibria can arise (Figure 4):

$$\pi = \pi^s if\ t^d < t_m < t^h$$

$$\pi < \pi^s if\ t_m < t^d \qquad (33)$$

$$\pi > \pi^s if\ t_m > t^h$$

FIGURE 4



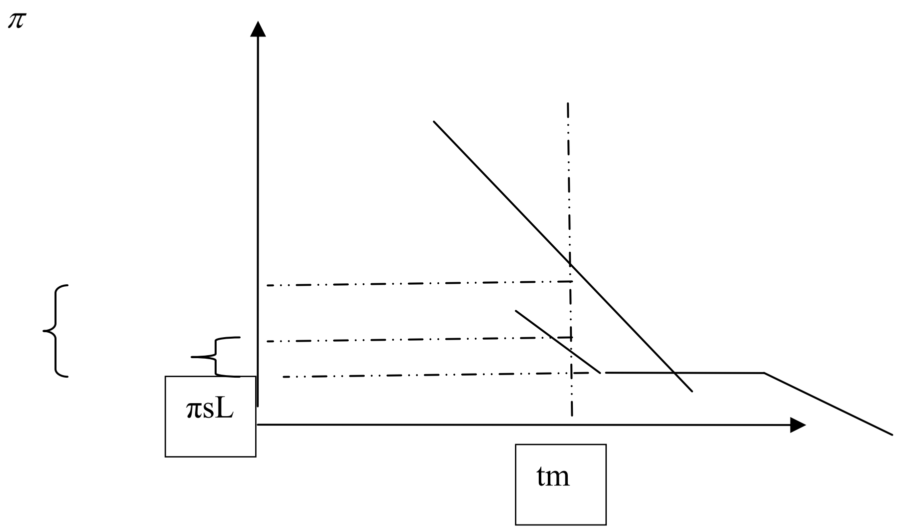
The existence of loss aversion influences the monetary decisions under three different points of view:

1) *Moderation Effect*: The policy outcome will be the status quo inflation π^s if the median voter is a pigeon. Further, given that the distance between $t^d \, and \, t^h$ is increasing in $z > 0$, the more the loss aversion is increasing the more likely median voter is to be a pigeon: a status quo bias in monetary strategy – i.e. monetary inertia - will emerge. In other words more loss aversion among MPC members reduces the distance between their monetary policy positions. On the one side the doves overestimate the inflation cost, so they limit their dovishness. On the other side the hawks overestimate the reduction in macro stabilization, as well as seigniorage losses, and therefore their hawkishness is dampened. As the central bankers become more loss averse, pigeons increase in number and inertia in setting the interest rate is likely to increase. In other words being i^* the equilibrium interest rate and i_m the median (pigeon) interest rate, we have that increasing loss aversion triggers interest rate inertia, i.e. :

$$i^* = i_m = i^s if z > 0 \rightarrow \qquad (34)$$

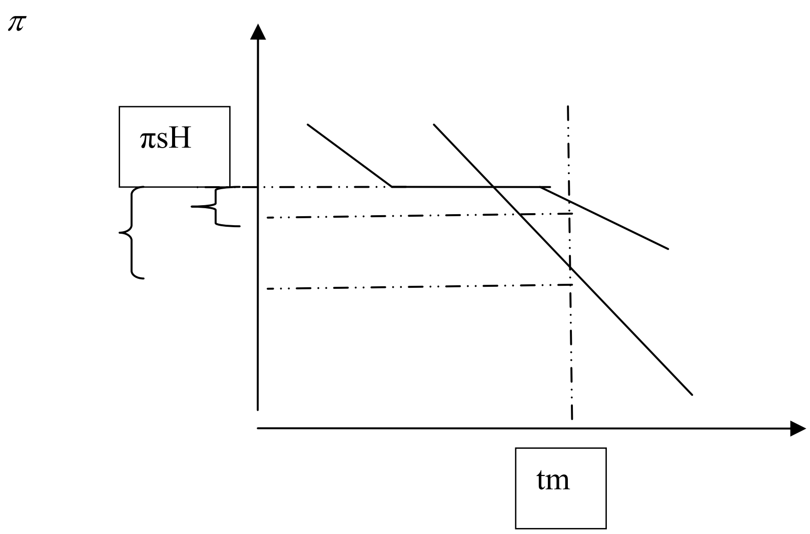
2) *Hysteresis Effect*: The status quo will influence the monetary strategy also if the median voter is either a dove or a hawk. First of all, let us assume that status quo inflation π_L^s is too low for the median central banker (Figure 5): needless to say, she will overestimate the increase in inflation costs, and the optimal inflation rate – as well as the optimal interest rate – will be relatively low.

FIGURE 5



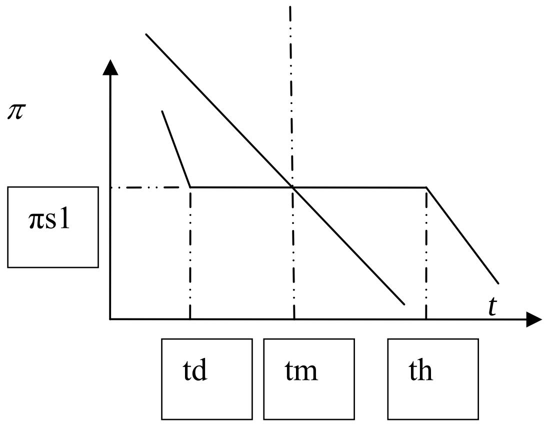
In a mirror-like way, also the opposite is true: suppose that the status quo inflation π_H^s is too high for the same median central banker (Figure 6): in this case she will overestimate output stabilization losses, and the optimal inflation rate will be relatively high. In other words the status quo produces a hysteresis effect in monetary policy decisions.

FIGURE 6



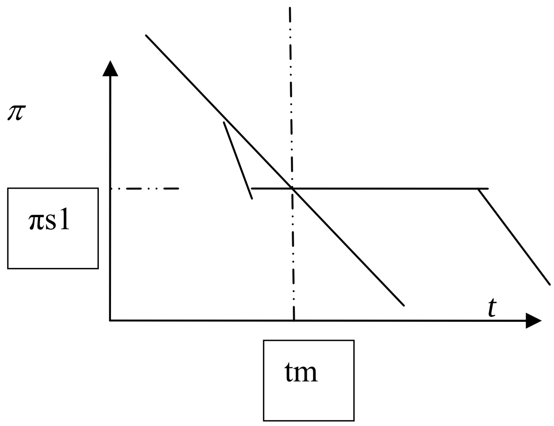
3) *Smoothing* effect: in case of a shock to the level of conservativeness, only large shocks can trigger a change in the monetary policy stance. Let us assume we are in a situation of status quo equilibrium π_1^s (Figure 7) and that the median central banker is a pigeon:

FIGURE 7



Suppose now that a shock τ hits the degree of conservativeness of the central bankers; for example dovishness increases. Two cases can occur. If the shock is relatively low (Figure 8), the median central banker is likely to remain a pigeon, and the optimal monetary policy will stay the same:

FIGURE 8

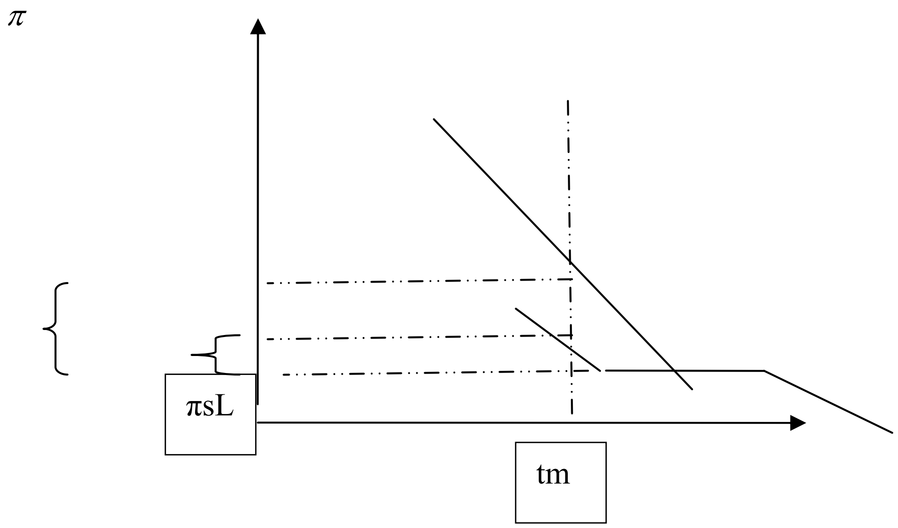


In other words:

$$i^* = i_m = i^s if \tau \rightarrow 0 \quad (35)$$

Only if the shock is relatively strong, status quo inflation π_1^s becomes too low for the median central banker (Figure 9): however – as we already highlighted discussing the hysteresis effect - she will overestimate the increase in inflation costs, and the optimal inflation rate – as well as the optimal interest rate - turns out to be relatively low.

FIGURE 9



Summing up: as central bankers become more loss averse, both dovishness and hawkishness decrease in a stable way, triggering higher monetary policy inertia, which is independent from both the existence of frictions, governance features and central bankers' preferences. In the Appendix we show that using a different central bank goal function, but consistent with our assumptions,monetary inertia equilibrium is replicated.

With behavioral biases in the MPC members monetary policy inertia – i.e. as usual a significant autocorrelation coefficient $\varsigma > 0$ in the interest rate path – is more likely to occur if loss aversion is a significant phenomenon, i.e. $z > 0$:

$$i^*_{m,t} = \xi i_{m,t-1} + \gamma_\pi \rho \pi_t + \frac{1}{\varphi} g_t \qquad (36)$$

4. CONCLUSION

Using a standard macroeconomic model the goal of this article is to introduce a novel perspective to analyze monetary inertia, discussing issues that are becoming increasingly relevant in the real world: how important are behavioral drivers in explaining the monetary policy decisions? What are the consequences – if any – for monetary policy strategy and the design of central bank governance rules?

In this paper we study an economy with nominal price rigidities and rational expectations where a Monetary Policy Committee (MPC) makes decisions on interest rates using a majority rule. The central bankers are top bureaucrats that care about their careers and can be divided into three groups, depending on their monetary conservativeness: doves, pigeons and hawks. Given their degree of conservativeness, we show that the introduction of loss aversion in the individual behavior influences the monetary policy stance under three different but convergent perspectives. First of all a *Moderation Effect* can emerge, i.e. the number of pigeons increases. At the same time also a *Hysteresis Effect* can become relevant: both doves and hawks smooth their attitudes. Finally a *Smoothing Effect* tends to stabilize the number of pigeons. The three effects consistently trigger higher monetary policy inertia. Loss aversion can explain delays and lags in changing the monetary policy stance, including the so called fear of lift offs after recessions. Needless to say, the behavioral motivation doesn't rule out the other motivations already stressed in the literature.

Our results shed light on the fact that central bankers are individuals that are subject to the same source of behavioral bias all individuals face. In the presence of behavioral bias the outcome of different information sets and/or governance rules can be quite different with respect to the standard case.

On the one side we reminded readers that monetary inertia can emerge in a standard setting where the central banker aims to design and implement the best monetary policy considering the possible macroeconomic trade offs. However one more perspective needed to be explored, namely to assume that central bankers can act consistently with behavioral biases.

On the other side and in general, governance rules are defined assuming the existence of a principal agent framework between citizens and central bankers as bureaucrats, where the bureaucrats are rational players. Therefore the governance problem is to design rules of the game that can produce optimal interest alignment between society and central bankers.

In this paper we adopt the principal agent perspective in the more general and simple way, i.e. the individual central banker incorporates social gains and costs in implementing via monetary action successful stabilization policies, taking into account her personal conservativeness. But then we show that the less central bankers are rational individuals in the traditional meaning, the more the design of governance procedures must take into account the possibility of behavioral bias. In other words, the simple assumption that central bankers are career-motivated player whotcare about their prestige are not sufficient when behavioral biases – such as loss aversion – can systematically emerge. In calculating benefits and losses of different monetary policies, behavioral central bankers make choices that are quite different with respect to standard central bankers.

It is worth noting that loss aversion is just one source of behavioral bias. As it has been correctly pointed out[13] in general the cognitive psychology perspective can be usefully employed in understanding the intertemporal challenges embedded in monetary policy analysis.

Therefore the analysis of central bank governance must take into account the relevance of behavioral biases. In order to zoom in on the relevance of loss aversion we adopt the simplest governance framework: an independent central bank where monetary policy decisions are made by the MPC by simple majority voting. The simple majority model has the property of being frictionless - i.e. the status quo doesn't matter – and consequently it is an ideal setting to show how the introduction of loss aversion can shape the monetary setting. Needless to say, future research shall devote additional effort to uncover the relationship between behavioral bias and alternative governance settings.

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All in all behavioral economics deserves increasing attention; monetary policy analysis should account for the fact that central bankers are individuals and prone to biases and temptations that can sensibly influence their ultimate choices in the setting of macroeconomic and/or interest rate targets. Theoretical, institutional and empirical studies are needed, also to address in a systematic way the intrinsic difficulty in disentangling case by case when a monetary stance represents a case of information, governance or behavioral inertia, respectively. But from an empirical point of view it is all but straightforward to disentangle conditions (13), (25) and (36), i.e. informational inertia, governance inertia and behavioral inertia.

Last but not least, our analysis is positive; the normative consequences deserve to be carefully assessed by future research.

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6. APPENDIX: PROFESSIONAL CENTRAL BANKER, LOSS AVERSION AND MONETARY POLICY INERTIA

Let us assume that $V(t,\pi)$ be the individual utility function of the central banker (i) :

$$V(t_i,\pi) = t_i + H(\pi) - \frac{t_i \pi^2}{2t} \qquad (37)$$

Here we are assuming that the central banker's utility is increasing with her conservativeness, being a top bureaucrat whose professional reputation is associated with her hawkishness. For the sake of simplicity we also assume that the function is quadratic in costs:

$$V(t_i,\pi) = t_i + 2\pi^{0.5} - \frac{t_i \pi^2}{2t} \qquad (38)$$

The optimal inflation rate is equal to:

$$\pi_i^{**} = (\frac{\hat{t}}{t_i})^{2/3}$$

Where $\hat{t}$ is the conservativeness of the average central banker. It is worth nothing that the preferences that this goal function produces are consistent: doves choose $\pi_D^{**} > 1$ while hawks prefer $\pi_H^{**} < 1$.

If π^S status quo inflation, with loss aversion the central bank function becomes:

$$V(t_i,\pi/\pi^S) = V(t_i,\pi) - z\frac{t_i}{2t}\left[\pi^2 - (\pi^S)^2\right] if \pi \geq \pi^S \qquad (39)$$

$$V(t_i,\pi/\pi^S) = V(t_i,\pi) - z\left[H(t_i,\pi^S) - H(t_i,\pi)\right] if \pi < \pi^S \qquad (40)$$

With the quadratic specification:

$$V(t_i,\pi/\pi^S) = V(t_i,\pi) - z\frac{t_i}{2t}\left[\pi^2 - (\pi^S)^2\right] if \pi \geq \pi^S \qquad (41)$$

$$V(t_i,\pi/\pi^S) = V(t_i,\pi) - z\left[2(\pi^S)^{0.5} - 2\pi^{0.5})\right] if \pi < \pi^S \qquad (42)$$

The optimal conditions are as follows:

$$V_\pi(t_i,\pi) = \frac{\partial}{\partial \pi}(\frac{t_i}{2t}\left[\pi^2 - (\pi^S)^2\right]) if \pi \geq \pi^S \qquad (43)$$

$$V_\pi(t_i,\pi) = \frac{\partial}{\partial \pi}(z\left[2(\pi^S)^{0.5} - 2\pi^{0.5}))\right] if \pi < \pi^S \qquad (44)$$

πsL

Now the dove central banker will be characterized by a level of conservativeness $\overset{d}{t}$, such that:

$$t^d = \frac{\hat{t}}{(1+z)\pi^{3/2}} \qquad (45)$$

While the hawk central banker will be characterized by a level of conservativeness $\overset{h}{t}$, such that:

$$t^h = \frac{(1+z)\hat{t}}{\pi^{3/2}} \qquad (46)$$

Where $\overset{d}{t} < \overset{h}{t}$

Again every MPC can be split in three different groups: doves - $ift_i < \overset{d}{t}$ - hawks - $ift_i > \overset{h}{t}$ and pigeons - $if\ t^d < t < \overset{h}{t}$

The optimal inflation rate will depend on the average conservativeness $\hat{t}$, having three possibilities: dove, pigeon and hawks. The three different equilibria are as follows:

$$\pi = \left(\frac{t_i(1+z)}{\hat{t}}\right)^{2/3} ift_i < t^d$$

$$\pi = \pi^s ift^d < t_i < t^h \qquad (47)$$

$$\pi = \left(\frac{t_i}{(1+z)\hat{t}}\right)^{2/3} if\ t_i > t^h$$

Also in this case the *Moderation Effect*, the *Hysteresis Effect* and the *Smoothing Effect* emerge in equilibrium, triggering monetary policy inertia.