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WORKING PAPER SERIES Nº 2026-10

DEPARTMENT OF ECONOMICS, FEA-USP
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Keywords: Stabilization policy, heterogeneous expectations, satisficing evolutionary dynamics.

JEL Codes: C73, E12, E52.

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March 2026

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1 Introduction

There exists a general concern in macroeconomics with anchoring private-sector expectations in an effort to facilitate the pursuit of stabilization policy. Recent examples, with particular focus on anchoring inflation expectations, include Carvalho et al. (2023), Naggert et al. (2023), Baumann et al. (2025), and Apokoritis et al. (2025). This concern makes obvious sense when, either by virtue of their cognitive limitations or the nature of the macroeconomic environment itself (or both), private-sector decision makers face uncertainty rather than calculable risk, and so rely on heuristics when forming expectations about macroeconomic variables of interest. Such heuristics can and apaprently do vary within the general population: there is considerable empirical evidence from both survey data and laboratory experiments suggesting that that inflation and output expectations are persistently heterogeneous, and formed through boundedly rational, norm-based mechanisms or heuristics (see, for example, Hommes, 2011, 2021). This heterogeneity is not surprising if private decision makers confront uncertainty rather than just calculable risk, there being little reason to think that a single salient method of forming expectations will necessarily assert itself in this decision-making environment. Heterogeneity of this sort was, of course, anticipated by Keynes in *The General Theory* (1936), where there is clear recognition that private decision makers differ with respect to their access to information, information-processing and forecasting methods and capabilities, and even basic attitudes towards the future.[1]

In addition to displaying heterogeneity in their forecasting methods at any given point in time, private decision makers may switch between forecasting heuristics over time. The most obvious

[1] Keynes's famous distinction between speculation and enterprise in Chapter 12 of *The General Theory* comes to mind with respect to this last source of potential heterogeneity. Speculation is defined as the activity of forecasting the psychology of the market, whereas enterprise is characterized as the activity of forecasting the prospective yield of assets over their whole life. For Keynes, "[s]peculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done" (Keynes, 1936, p. 159).

basis for such behaviour is observed macroeconomic performance and its departure from some benchmark standard of reference—such as a policy target intended by policy makers to anchor expectations. Private decision makers may also switch between forecasting heuristics for reasons unrelated to observed macroeconomic performance. For example, actual or even threatened changes to the organizations and/or persons responsible for the conduct of policy may affect the salience of a policy target as a basis for forming expectations. As will become clear, both performance and non-performance related factors—as well as objective and subjective determinants—are taken into account in what follows, in the analysis of forecasting strategies and movement within the general population of private decision makers between them.

Lima et al. (2014) show that, in an environment of the sort described above, macro stabilization policy can be (perhaps) surprisingly successful: the dynamics of switching between heterogenous forecasting strategies act as a pseudo policy tool, so that even when policy makers use fewer (formal) policy instruments than they have targets—thus seemingly violating the Tinbergen principle—the economy can be stabilized at equilibrium outcomes consistent with policy maker's targets. This result holds even without complete anchoring of expectations—i.e., without the policy authorities ever convincing all private-sector decision makers to align their expectations with announced policy targets—and even when these decision makers are capable of spontaneously switching between forecasting strategies (that is, switching for reasons other than those associated with observed macro performance). There are, however, factors that can complicate these results. For example, Lima et al. (2014) show that imitation—a proclivity of agents to adopt a forecasting strategy that is observably popular with others—introduces potential instability.[2] The possibility that 'other people know better' cannot be ruled out in an environment of uncertainty populated by heterogeneous decision makers, and imitation may be

[2] Imitation is, of course, another acknowledgement of the sort of mechanisms contemplated by Keynes in *The General Theory*—although it is far from obvious that it need always give rise to instability. While the term 'imitation' is a modern analytical descriptor, the mechanism itself is the foundation of the 'conventional judgement' discussed in Chapter 12 of *The General Theory*.

associated, therefore, with a productive process of 'social learning' (Chamley, 2004).

In this paper, we build on previous work by Lima et al. (2014) and Lima et al. (2025), in particular by endowing the process of expectation formation and revision with richer dynamics. Specifically, we: introduce output (as well as inflation) expectations to allow for the absence of 'natural' values of real variables that automatically anchor real-sector expectations; introduce 'intensive' margins of credulity and incredulity to allow for gradable degrees of commitment to (or scepticism towards) the policy authorities' target values of output and inflation; and reformulate the way in which incredulous agents respond to the failure of policy authorities to realise their policy targets, making the revision of their expectations an increasing function of any gap between actual outcomes and their target values. These modifications test the robustness of the key result in Lima et al. (2014) and Lima et al. (2025): the general existence and stability of a macroeconomic equilibrium configuration consistent with policy makers' targets despite seeming violation of the Tinbergen principle.[3]

Our analysis reveals that even with the modifications to forecasting behaviour outlined above, it is still possible for policy makers to successfully pursue two policy targets with one policy instrument, aided in their pursuit of these targets by the dynamics of evolving heterogeneous expectations in the private sector. In other words, evolving heterogeneous expectations are an important potential facilitator of the achievement of two policy targets as a stable equilibrium configuration. Our results do reveal potential sources of instability other than those identified by Lima et al. (2014) and Lima et al. (2025), however. They also suggest that the *timeliness* of policy intervention may matter—although whether or not policy makers are in a position to exploit this possibility, given the nature of the decision-making environment and its effects on their capacity for action (as well as that of private decision makers) is open to debate.

[3] As will become clear in what follows, the policy authorities pursue two policy targets using only one policy instrument.

The remainder of the paper is organized as follows. Section 2 outlines our model, paying particular attention to the properties of the heterogeneous forecasting strategies employed by private-sector decision makers who treat policy makers' targets as either credulous or incredulous. Section 3 analyses the dynamics of this model when there is a given distribution of credulous and incredulous agents in the general population. In section 4, the distribution of credulity/incredulity is endogenized by the means of introducing criteria that induce agents to switch between forecasting strategies. Section 5 offers some conclusions, including reflections on the possibility that faster policy intervention—to the extent that it is possible to conceive and implement given the nature of the decision-making environment—may be conducive to macroeconomic stabilization.

2 The macroeconomic setting

The basic macroeconomic model on which the analysis in this paper is based can be stated as follows:

(1) $$y = y_0 - \delta(r - p^e) + \gamma y^e,$$

(2) $$p = \beta + \varphi p^e + \alpha y \ ,$$

(3) $$\dot{r} = \mu(p - p^T) + \lambda(y - y^T),$$

(4) $$\dot{p}^e = k\dot{p}^e_i + (1-k)\dot{p}^e_c = \Phi(\eta_i, \eta_c, k)(p - p^T), \text{ with } \Phi(\eta_i, \eta_c, k) \equiv k\eta_i - (1-k)\eta_c \ ,$$

(5) $$\dot{y}^e = k\dot{y}^e_i + (1-k)\dot{y}^e_c = \Psi(\theta_i, \theta_c, k)(y - y^T), \text{ with } \Psi(\theta_i, \theta_c, k) \equiv k\theta_i - (1-k)\theta_c \ ,$$

where y and y^e denote the levels of actual and expected real output, respectively, y_0 represents non-interest and non-income sensitive components of aggregate spending, r is the nominal interest rate, p and p^e are the actual and expected rates of inflation, respectively, y^T and p^T denote the policy authorities' target levels of real output and rate of inflation, respectively, whereas lower case Greek letters denote strictly positive parameters. As usual, a dot over a variable denotes its rate of change (i.e., $\dot{x} = dx/dt$). Meanwhile, $k \in [0, 1] \subset \mathbb{R}$ denotes the extensive margin of incredulity as represented by the fraction of incredulous agents who form expectations in accordance with observed inflation, and $1 - k$ denotes the extensive margin of credulity as represented by the fraction of credulous agents whose expectations are anchored to the inflation target. Both k and (by extension) $1 - k$ vary endogenously over time in a manner that is described below. The parameters $\eta_i \in [0, \infty) \subset \mathbb{R}$ and $\theta_i \in [0, \infty) \subset \mathbb{R}$ designate the intensive margins of incredulity with respect to the attainment of the official target levels of rate of inflation and real output, respectively, and the parameters $\eta_c \in [0, 1) \subset \mathbb{R}$ and $\theta_c \in [0, 1) \subset \mathbb{R}$ designate the intensive margins of credulity regarding the achievement of the official target levels of rate of inflation and real output, respectively—what can be referred to as the intensity of inflation/output target incredulity and credulity, respectively. These parameters are treated as exogenously given constants. But the average net effects represented by Φ and Ψ in equations (4) and (5) vary endogenously over time in a manner that is described below. In fact, the average extensive margin and the average net intensive margin move together.

Taken together, equations (1)-(5) constitute a demand-led 3-equation macro model (equations (1) - (3))[4], augmented by a description of how expectations of the two key variables that are the targets of stabilization policy—output and inflation—are formulated (equations (4) and (5)). In what follows, we describe each of these two sub-systems of our model in greater detail.

2.1 The 3-equation model

Equation (1) is an expectations-augmented aggregate demand schedule, in which current output is decreasing in the expected real interest rate and increasing in expected output, via the hypothesized effects of the expected real interest rate and level of output (and hence income) on current spending. Equation (2) is an expectations-augmented Phillips curve, in which $\varphi < 1$,

[4] See, for example, Setterfield (2009).

consistent with the idea that workers lack the bargaining power to fully index expected inflation into nominal wage growth. This is rooted in the surplus approach to value and distribution and results in a long run (direct) relationship between output and inflation in equation (2) that is, itself, consistent with the idea that there is no unique (supply-determined) 'natural' level of output. Equation (3), meanwhile, describes the conduct of monetary policy which, in accordance with the Post Keynesian theory of endogenous money, takes the form of an interest rate operating procedure. Monetary policy is conducted in a manner that bears resemblance to a Taylor rule, with the central bank varying the nominal interest rate positively (negatively) whenever current inflation or output is above (below) its official target. In accordance with the real and monetary foundations of our model as outlined above there is, however, no 'natural' (or 'neutral') real interest rate acting as a centre of gravity for the actual real interest rate. This is in keeping with the absence of a supply-determined 'natural' level of output as previously noted.

In contrast to the model in Lima et al. (2014) on which we are building, the 3-equation system stated above involves no incomes policy: monetary policy is the only source of policy intervention.[5] In addition, our model incorporates further channels of interaction between macroeconomic variables and a richer specification of expectation formation (now including an intensive margin of credulity and incredulity) designed to improve its realism. The central bank uses Taylor-type reaction function that targets both output and inflation, acting directly on the nominal interest rate in response to both inflation and/or output gaps. Furthermore, output expectations affect demand formation and hence current output, consistent with the Keynesian theme that expectations are a pervasive influence on macroeconomic outcomes, affecting and being affected by the configuration of the real economy (as well as the inflation process).

[5] This is a straightforward simplification: as Lima et al. (2014) show in a simpler model, the absence of an incomes policy (and seeming violation of the Tinbergen principle) does not affect the success of stabilization policy.

2.2 Forecasting strategies

As is obvious by inspection, equations (4) and (5)—which describe aggregate variation in the forecasting strategies of private-sector decision makers with respect to inflation and output (respectively)—are similar in terms of their formal structure. In light of this, we describe the formal derivation of equation (4) in detail in what follows, making only brief remarks about equation (5). Details of the derivation of equation (5) are included in the appendix A to this paper.[6]

Equation (4) is formally derived as follows. Let us suppose that the private sector varies its expectation with respect to the course of a deviation of current inflation from its official target in a direction and magnitude that depends on the level of such a deviation. Note that for a given strictly positive or negative deviation of current inflation from its official target, the rate of change of the expectation of the private sector with respect to such a deviation is determined by rate of change of its expected inflation and the rate of change of its expected inflation target. We assume for simplicity that the private sector takes the official inflation target as being exogenously determined by the monetary policy makers, and does not expect this target to change over the forecasting time horizon.[7] This means that the expected rate of change of the inflation target is zero.

Consequently, the expected rate of change of the deviation of current inflation from its official target is determined solely by the expected rate of change of inflation. Meanwhile, the private sector's expected rate of change of inflation is a weighted average of incredulous agents' expected rate of change of inflation ($\dot{p}_i^e$) and credulous agents' expected rate of change

[6]Note that the credulity and incredulity featuring in equations (4) and (5) are complete, in the sense that a private-sector decision maker is credulous or incredulous about the achievements of both policy targets. We abstract from and leave for future research the possibility of either credulity or incredulity being incomplete, applying to one policy target but not the other.

[7]It is possible, for example, that a gap $p - p^T < 0$ is seen as being so large that agents expect policy makers to revise downwards or upwards their official inflation target. Alternatively, suppose that policy makers announce a reduction in the inflation target, but incredulous agents do not believe that this announcement will be acted upon for want of political space, perhaps. We leave consideration of these and other related possibilities to further research.

of inflation ($\dot{p}_c^e$): that is, $\dot{p}^e = k\dot{p}_i^e + (1-k)\dot{p}_c^e$. As in Lima et al. (2014), credulous agents are assumed to expect the (full or at least partial) convergence of current inflation to the official policy target, p^T, in the near future. However, differently from Lima et al. (2014), incredulous agents are assumed to expect inflation to further deviate from the target unless the target has already been achieved, the implication of which is that we formally have $\dot{p}_c^e = -\eta_c(p - p^T)$ and $\dot{p}_i^e = \eta_i(p - p^T)$, recalling that $\eta_c \in (0, 1] \subset \mathbb{R}$ and $\eta_c \in [0, \infty) \subset \mathbb{R}$ are parametric constants. In other words, a credulous agent expects that the deviation represented by $p - p^T$ will be at least partially (or, when $\eta_c = 1$, even fully) reduced, while an incredulous agent expects that this gap will remain unchanged only when it is equal to zero (i.e., when the inflation target has been achieved), or when $\eta_i = 0$, and will rise monotonically otherwise – so that the incredulity of incredulous agents is now instantaneously increasing (in absolute terms) in any deviation of inflation from its announced target value.[8]

Therefore, it is only when the inflation target has been achieved, or when $\eta_i = 0$, that an incredulous agent does not consider it necessary to expect change in the rate of inflation. In particular, any strictly positive or negative gap $p - p^T \neq 0$ is expected by an incredulous agent to cause further variation in this gap of size $\eta_i|p - p^T|$, since the expected change in the considered inflation gap by both types of private decision makers is represented by $E_\tau\left[\frac{d(p-p^T)}{dt}\right] = E_\tau\left[\frac{dp}{dt}\right] - E_\tau\left[\frac{dp^T}{dt}\right] = \dot{p}_\tau^e$, given that the official inflation target is expected to remain constant by the private sector as a whole (so that $E_\tau\left[\frac{dp^T}{dt}\right] = 0$ for $\tau = c, i$). Substituting the expressions for $\dot{p}_c^e$ and $\dot{p}_i^e$ stated above into the expression for $\dot{p}^e$ as previously stated yields equation (4).

[8]Note that incredulous agents are incredulous about the prospect of achieving policy targets, but not about the prospect of their maintenance. An especially 'hard' incredulity (or extreme pessimistic view) would involve the expectation that achievement of an official target will not be maintained, even if the target is achieved in a given moment in time. We abstract from this extreme incredulity verging on extreme pessimism.

2.3 Intensive and extensive margins of (in)credulity

The function $\Phi(\eta_i, \eta_c, k) \equiv k\eta_i - (1-k)\eta_c$ in equation (4) is a composite coefficient denoting the adjustment of the expected inflation to a non-null inflation gap represented by $p - p^T$. If $\Phi(\eta_i, \eta_c, k) < 0$ ($\Phi(\eta_i, \eta_c, k) > 0$), given the intensity of incredulity and credulity represented by η_i and η_c, respectively, the extensive margin of incredulity with respect to the achievement of the inflation target represented by k is relatively low (high), so that the weighted average of the expected rate of change of inflation in equation (4), represented by $\dot{p}^e = k\dot{p}_i^e + (1-k)\dot{p}_c^e$, will have the opposite sign of (same sign as) the inflation gap represented by $p - p^T$. Or, given the extensive margins of incredulity and credulity represented by k and $1-k$, respectively, the intensity of incredulity (credulity) with respect to the achievement of the inflation target, which is given by η_i (respectively η_c) is relatively low (high), so that the weighted average of the rate of change of expected inflation in equation (4) will have the opposite sign of (same sign as) the gap indicated by $p - p^T$.

Therefore, the composite coefficient $\Phi(\eta_i, \eta_c, k)$ measures the net total incredulity in the achievement of the official inflation target, so that when $p - p^T > 0$, it follows that $\dot{p}^e > 0$ ($\dot{p}^e < 0$) if $\Phi(\eta_i, \eta_c, k) > 0$ ($\Phi(\eta_i, \eta_c, k) < 0$). In fact, let $\tilde{k} \equiv \dfrac{\eta_c}{\eta_i + \eta_c} \in (0, 1] \subset \mathbb{R}$ be the critical value of the extensive margin of incredulity in the achievement of the official inflation target which results in $\Phi(\eta_i, \eta_c, \tilde{k}) = 0$. Since $\dfrac{\partial \Phi}{\partial k} = \eta_i + \eta_c > 0$, we have that $\Phi(\eta_i, \eta_c, k) < 0$ when $0 \leq k < \tilde{k}$, whereas $\Phi(\eta_i, \eta_c, k) > 0$ when $\tilde{k} < k \leq 1$. Given that $\lim_{\eta_i \to \infty} \tilde{k} = 0$, it follows that for intensities of incredulity sufficiently high, we have that $\Phi(\eta_i, \eta_c, k) > 0$ no matter how low (yet strictly positive) the extensive margin of incredulity happens to be. Also—and as might reasonably be expected—the combination of intensive margins of incredulity and credulity that is most favorable to stabilization policy, represented by $(\eta_i, \eta_c) = (0, 1)$, results in $\tilde{k} = 1$. In this benign case, we necessarily have that $\Phi(\eta_i, \eta_c, k) < 0$ for any $k \in [0, 1) \subset \mathbb{R}$, that is, the net total incredulity (credulity) in the achievement of the inflation target is negative (positive) and hence works in an inflation-gap-reducing manner. In fact, note that the function $\Phi(\eta_i, \eta_c, k)$ takes its minimum value when the intensity of incredulity (credulity) is the lowest (highest), that is, $\Phi(0, 1, k) = -(1-k)$. More broadly, we have that $\Phi(\eta_i, \eta_c, 1) = \eta_i$ and $\Phi(\eta_i, \eta_c, 0) = -\eta_c$ are, respectively, the maximum and minimum value of the function $\Phi(\eta_i, \eta_c, k)$ for any given combination (η_i, η_c).

In sum, the expected rate of change of inflation depends not only on the deviation of inflation from its official target and the frequency distribution of expectation-formation strategies in the private sector—which measures the extensive margin of (in)credulity in the achievement of the inflation target—but also on both the intensity of incredulity and credulity η_i and η_c, respectively. Given the proportion of incredulous and credulous agents in the private sector, the net total incredulity (credulity) in the achievement of the inflation target falls (increases) along the intensive margin as η_i (respectively η_c) tends to zero (one), since $\frac{\partial \Phi}{\partial \eta_i} = k > 0$ and $\frac{\partial \Phi}{\partial \eta_c} = -(1-k) < 0$. Besides, note that $\Phi(\eta_i, 0, k) = k\eta_i > 0$ is the maximum value taken by the net total incredulity if the respective intensive margin of incredulity is finite, whereas $\lim_{\eta_i \to \infty} \Phi(\eta_i, \eta_c, k) = \infty$ for any $\eta_c \in (0, 1] \subset \mathbb{R}$ and $k \in (0, 1] \subset \mathbb{R}$. Thus, no matter how low (yet strictly positive) the extensive margin of incredulity k, the net total incredulity tends to infinity if the respective intensity of incredulity tends to infinity. Meanwhile, given the intensity of incredulity (η_i) and credulity (η_c), the net total incredulity (credulity) in the achievement of the official inflation target increases along the extensive margin as k tends to one (zero).

2.4 Forecasting strategies: a summary

As previously noted, equation (5) is formally similar to equation (4): it is derived in a manner similar to the derivation of ((4) as described above; and the implications of the intensity of incredultity (Θ_i) and credulity (Θ_c) for the function $\Psi(\cdot)$ are similar to the implications of η_i and η_c for $\Phi(\cdot)$ as previously described, and can be deduced in a manner analogous to the analysis of $\Phi(\cdot)$ in the previous section if we define $\bar{k} \equiv \dfrac{\theta_c}{\theta_i + \theta_c} \in (0, 1] \subset \mathbb{R}$ as the critical value of the extensive margin of incredulity in the achievement of the output target that yields $\Psi(\eta_i, \eta_c, \bar{k})$. As previously noted, details of the derivation of equation (5) are provided in the appendix A to this paper.

Our treatment of forecasting strategies contrasts with that of Lima et al. (2014). Specifically, the heterogeneity of expectations is embellished in several behaviourally sound ways. First, output expectations are introduced, consistent with the fact that in a Post Keynesian economy private-sector decision makers must form and rely on expectations of real variables such as y (much as they depend on expectations of nominal variables such as p) because of the absence of any 'natural' values towards which real variables will automatically and inevitably converge either on their own or as a result of some optimal monetary policy. Second, new 'intensive margins' of credulity and incredulity are introduced to capture the fact that credulity and incredulity are *gradable*: for any given *proportion* of the population that is credulous (incredulous), the intensity of their credulity (incredulity) may vary, with potential implications for macrodynamics and stabilization policy. The average net effects represented by Φ and Ψ in equations (4) and (5) will vary endogenously over time with the proportion of incredulous agents. Meanwhile, the average extensive margin and the average net intensive margin will move together and in the same direction.

Finally, a new account of the expected rate of change of inflation of incredulous agents is provided, according to which incredulous agents expect a further increase (decrease) in inflation whenever inflation exceeds (falls short of) the inflation target. This is still what Lima et al. (2014) call the "incredulity of Saint Thomas", in the sense that incredulous agents only question the veracity of a policy target when it is *not* achieved. But now any deviation from the policy authority's targets leads an incredulous agent to expect the deviation to increase further (rather than remain constant), unless $\eta_i = 0$. When policy targets are not achieved, incredulous agents now act in a manner that is implicitly forward looking and based on a subjective model of the economy that recognizes the *self-aggravating persistence* of inflation and output dynamics—so that once inflation/output rises (falls) above (below) its target, it is expected to keep rising (falling) over time, even if it eventually converges to a constant higher (lower) medium- or long-run rate.

2.5 The complete macrodynamic system

By combining equations (1)-(5), we get a dynamic system that can be solved for macroeconomic equilibrium for a given extensive margin of credulity of the private sector in the policy authorities' commitment and ability to achieve their targets (p^T, y^T)—i.e., for a given proportion of credulous agents, $1-k$. First, note that from equation (1):

$$\dot{y} = -\delta(\dot{r} - \dot{p}^e) + \gamma\dot{y}^e, \tag{6}$$

which, using equations (3)-(5), can be written as:

$$\begin{aligned}
\dot{y} &= -\delta(\dot{r} - \dot{p}^e) + \gamma\dot{y}^e \\
&= -\delta(\mu(p-p^T) + \lambda(y-y^T) - \Phi(\eta_i,\eta_c,k)(p-p^T)) + \gamma\Psi(\theta_i,\theta_c,k)(y-y^T) \\
&= [-\delta\lambda + \gamma\Psi(\theta_i,\theta_c,k)](y-y^T) + \delta[-\mu + \Phi(\eta_i,\eta_c,k)](p-p^T) \\
&= a(y-y^T) + b(p-p^T),
\end{aligned} \tag{7}$$

where $a \equiv -\delta\lambda + \gamma\Psi(\theta_i,\theta_c,k)$ and $b \equiv \delta[-\mu + \Phi(\eta_i,\eta_c,k)]$.

Similarly, equation (2) yields:

$$\dot{p} = \varphi\dot{p}^e + \alpha\dot{y}, \tag{8}$$

Substituting equations (4) and (7) in equation (8), we arrive at:

$$
\begin{aligned}
\dot{p} &= \phi \dot{p}^e + \alpha \dot{y} \\
&= \phi \Phi(\eta_i, \eta_c, k)(p - p^T) + \alpha[-\delta\lambda + \gamma\Psi(\theta_i, \theta_c, k)](y - y^T) + \delta[-\mu + \Phi(\eta_i, \eta_c, k)](p - p^T) \qquad (9) \\
&= \alpha a(y - y^T) + c(p - p^T),
\end{aligned}
$$

where $c \equiv (\varphi + \alpha\delta)\Phi(\eta_i, \eta_c, k) - \alpha\delta\mu$.

Therefore, for a given vector of structural and policy parameters represented by $(\alpha, \beta, \gamma, \delta, \eta, \lambda, \varphi, \mu, \eta_i, \eta_c, \theta_i, \theta_c, y_0, p^T, y^T)$, the state transition of output and inflation depends not only on the macroeconomic state (y, p) itself, but also on the endogenously time-varying frequency distribution of credulity in the effectiveness of policy across private agents $(k, 1 - k)$.

3 Behaviour of the model for a given frequency distribution of credulity $(k, 1 - k)$

3.1 Existence and uniqueness of the macroeconomic equilibrium parameterized by k

Considering the system composed of equations (7) and (9), we have $\dot{y} = 0$ and $\dot{p} = 0$ for a given $k \in [0, 1] \subset \mathbb{R}$ if, and only if, the following condition is satisfied:

$$
\begin{bmatrix} a & b \\ \alpha a & c \end{bmatrix} \begin{bmatrix} y - y^T \\ p - p^T \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}. \qquad (10)
$$

The solution $(y - y^T, p - p^T) = (0, 0)$ of this homogenous linear system exists and is unique if, and only if, $a(c - \alpha b) \neq 0$ for all $k \in [0, 1] \subset \mathbb{R}$—that is, the first matrix in the LHS of equation (10) is non-singular, its determinant being non-zero. Firstly, note that $a \equiv -\delta\lambda + \gamma\Psi(\theta_i, \theta_c, k) \neq 0$ if $\Psi(\theta_i, \theta_c, k) \neq \frac{\delta\lambda}{\gamma}$, which is true for all $k \neq \bar{k} + \frac{\delta\lambda}{\gamma(\theta_i + \theta_c)}$, recalling that $\bar{k} \equiv \frac{\theta_c}{\theta_i + \theta_c} \in (0, 1] \subset \mathbb{R}$. Secondly, since $c - \alpha b = \varphi\Phi(\eta_i, \eta_c, k)$, we can conclude that $c - \alpha b \neq 0$ for any $\tilde{k} \equiv \frac{\eta_c}{\eta_i + \eta_c}$. In sum, the equilibrium configuration represented by $(y, p) = (y^T, p^T)$ exists and is unique for any $k \in [0, 1] \subset \mathbb{R}$ as long as $k \neq \bar{k} + \frac{\delta\lambda}{\gamma(\theta_i + \theta_c)}$ and $k \neq \tilde{k}$. Note that what this last condition implies is that a necessary condition for the existence and uniqueness of equilibrium is that there be some expected change in inflation: we cannot observe $k = \tilde{k} \Rightarrow \Phi(\cdot) = 0 \Rightarrow \dot{p}^e = 0$ in (4). This condition underscores the relevance of an expected change in inflation as a *pseudo-policy* instrument, potentially aiding the monetary authority in the pursuit of macroeconomic stabilization. However, as formally demonstrated below, the composition of an expected change in inflation (and output) between credulous and incredulous agents is also significant.

Note further that the numerator in $\tilde{k} \equiv \frac{\eta_c}{\eta_i + \eta_c}$ denotes the intensity of credulity in the achievement of the inflation target, while the denominator in $\tilde{k}$ represents the sum of the intensities of incredulity (η_i) and credulity (η_c) in the achievement of the inflation target. Therefore, $\tilde{k}$ is a measure of the proportional share of the intensity of credulity in the achievement of the inflation target in the total intensive margin. Not surprisingly, it follows that $\tilde{k}$ varies positively with η_c and negatively with η_i. Moreover, in the symmetric case where $\eta_c = \eta_i$, it follows that $\tilde{k} = \frac{1}{2}$. The economic interpretation of $\bar{k}$ is similar to that of $\tilde{k}$. In this case, the numerator in $\bar{k} \equiv \frac{\theta_c}{\theta_i + \theta_c}$ denotes the intensity of credulity in the achievement of the output target, while the denominator in $\bar{k}$ represents the sum of the intensities of incredulity (θ_i) and credulity (θ_c) in the achievement of this same target. Therefore, $\bar{k}$ measures the ratio of the intensity of credulity in the achievement of the output target to the total intensive margin. Not surprisingly, $\bar{k}$ varies positively with θ_c and negatively with θ_i, while in the symmetric case where $\theta_c = \theta_i$, it follows that $\bar{k} = \frac{1}{2}$.

Now recall from above that the equilibrium configuration represented by $(y, p) = (y^T, p^T)$

exists and is unique for any $k \in [0,1] \subset \mathbb{R}$ as long as $k \neq \bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}$ and $k \neq \tilde{k}$. Thus full symmetry in the intensive and extensive margins (that is, $\eta_i = \eta_c$, $\theta_i = \theta_c$ and $k = \frac{1}{2}$) implies that the solution $(y - y^T, p - p^T) = (0, 0)$ of the homogenous linear system composed of equations (7) and (9) does not exist. This is because the full symmetry configuration just stated yields $k = \bar{k} = \frac{1}{2}$, which violates the condition $k \neq \tilde{k}$. In this configuration, there is linear dependence and the respective isoclines $\dot{y} = 0$ and $\dot{p} = 0$ are parallel to each other. In short, the macrodynamic system we have derived cannot tolerate simultaneous symmetry in both of the two 'layers' of heterogeneity in (in)credulity—extensive and intensive—associated with private-sector forecasting strategies. Intuitively, full symmetry in the intensive and extensive margins (i.e., $\eta_i = \eta_c$, $\theta_i = \theta_c$, and $k = \frac{1}{2}$) implies that incredulity and credulity offset each other so that inflation and output expectations both cease to be endogenously time-varying. In this case the composite coefficients $\Phi(\eta_i, \eta_c, k)$ and $\Psi(\theta_i, \theta_c, k)$ are both equal to zero, so that it follows from equations (4) and (5), respectively, that $\dot{p}^e = 0$ even when the inflation gap is strictly positive or negative and $\dot{y}^e = 0$ even when the output gap is strictly positive or negative. The absence of full symmetry is a necessary condition for the existence and uniqueness of macroeconomic equilibrium.

3.2 Stability of the macroeconomic equilibrium parameterized by k

The Jacobian matrix of the system consisting of equations (7) and (9) evaluated around the equilibrium $(y, p) = (y^T, p^T)$ is given by:

$$J_1 = \begin{bmatrix} a & b \\ \alpha a & c \end{bmatrix}, \tag{11}$$

with the result that $det J_1 = a(c - \alpha b)$. Based on the analysis carried out previously, and given that $\dfrac{\partial a}{\partial k} = \gamma \dfrac{\partial \Psi}{\partial k} = \gamma(\theta_i + \theta_c) > 0$ and $\dfrac{\partial (c - \alpha b)}{\partial k} = \varphi \dfrac{\partial \Phi}{\partial k} = \varphi(\eta_i + \eta_c) > 0$, we know that $a < 0$ ($a > 0$) if $0 \leq k < \bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}$ $\left(\bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)} < k \leq 1\right)$, and $c - \alpha b < 0$ ($c - \alpha b > 0$) if $0 \leq k < \tilde{k}$ $\left(\tilde{k} < k \leq 1\right)$. Considering these properties, we can determine the sign of $detJ_1 = a(c - \alpha b)$ and, consequently, map the possibilities in terms of dynamic behaviour around the equilibrium $(y, p) = (y^T, p^T)$ with respect to k, which are summarized in Table 1.

Table 1: Disequilibrium dynamics and equilibrium types

Case			a	$(c-\alpha b)$	$detJ_1 = a(c-\alpha b)$	**Type of equilibrium**
$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}<\tilde{k}$	$0\leq k<\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$	1-a	$-$	$-$	$+$	sink or source
	$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}<k<\tilde{k}$	1-b	$+$	$-$	$-$	saddle-point
	$\tilde{k}<k\leq 1$	1-c	$+$	$+$	$+$	sink or source
$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}=\tilde{k}$	$0\leq k<\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$	2-a	$-$	$-$	$+$	sink or source
	$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}<k\leq 1$	2-b	$+$	$+$	$+$	sink or source
$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}>\tilde{k}$	$0\leq k<\tilde{k}$	3-a	$-$	$-$	$+$	sink or source
	$\tilde{k}<k<\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$	3-b	$-$	$+$	$-$	saddle-point
	$\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}<k\leq 1$	3-c	$+$	$+$	$+$	sink or source

Considering the results in Table 1, we can see that the equilibrium $(y,p)=(y^T,p^T)$ is saddle-point unstable when the extensive margin of incredulity (k) in the achievement of the official targets is strictly lower than $\tilde{k}\equiv\frac{\eta_c}{\eta_i+\eta_c}\in(0,1]\subset\mathbb{R}$ (resulting in $\Phi(\eta_i,\eta_c,\tilde{k})=0$, and consequently $\dot{p}^e=0$, for any non-null inflation gap), but strictly greater than $\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$, recalling that $\bar{k}\equiv\frac{\theta_c}{\theta_i+\theta_c}\in(0,1]\subset\mathbb{R}$ (case 1-b). In fact, as demonstrated above, in this case the determinant of the associated Jacobian matrix is strictly negative. The equilibrium outcome $(y,p)=(y^T,p^T)$ is also saddle-point unstable when the extensive margin of incredulity in the achievement of the policy targets, given by k, is strictly greater than $\tilde{k}\equiv\frac{\eta_c}{\eta_i+\eta_c}\in(0,1]\subset\mathbb{R}$ (resulting in $\Phi(\eta_i,\eta_c,\tilde{k})=0$, and hence $\dot{p}^e=0$, for any non-null inflation gap), but strictly lower than $\bar{k}+\frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$ (case 3-b). In fact, as also demonstrated above, in this case the determinant of the associated Jacobian matrix is strictly negative. Meanwhile, whether the equilibrium outcome $(y,p)=(y^T,p^T)$ is a sink or a source depends (in addition to the associated Jacobian matrix having a strictly positive determinant) on the sign of $trJ_1=a+c$. Yet, the sign of the expression $c\equiv(\varphi+\alpha\delta)\Phi(\eta_i,\eta_c,k)-\alpha\delta\mu$ is indeterminate. Therefore, the equilibrium can be a sink or a source.

Taken together, these results dovetail with our observations regarding the conditions necessary for the existence and uniqueness of equilibrium: the model has no tolerance for situations in which there is no change in expected inflation. Note, however, that such situations are special cases—not just in the mathematical sense, but because there is no reason to think that any economic process, market or administrative, would bring about the configurations of parameters required to produce them. In other words, outcomes that involve no change in expected inflation do not have compelling behavioural foundations. There is, therefore, both mathematical and *behavioural* generality to the claim that our model can produce a unique and stable equilibrium. As in Lima et al. (2014), it is once again the case that a single policy instrument can be used to successfully pursue two policy targets—even when neither of the targeted variables has a 'natural' value, determined independently of the other variable, to which it will automatically gravitate (as in a neoclassical system). This is because of the potential 'support' that the dynamics of heterogeneous expectations provide to stabilization policy, which support arises in the manner of an unintended positive externality. As formally explored in the following section, this potential positive externality is particularly salient when heterogeneity in agents' inflation and output expectations is endogenously time-varying.

4 Behaviour of the model when the extensive margin of incredulity is endogenous

Suppose that we now introduce a *noisy satisficing evolutionary dynamics* to describe variation in the extensive margin of incredulity, k, over time, as private-sector decision makers periodically switch between forecasting strategies in response to the success/failure of the policy authorities in achieving the two policy targets. The novel specification of this micro-structure combines elements of the noise satisficing evolutionary dynamics utilized in Lima et al. (2014)

and Lima et al. (2025).

As elaborated by Simon (1955, 1956), satisficing is a theory of choice centered on the process through which available alternatives are examined and evaluated. By conceiving of choice as intending to meet an acceptability threshold rather than to select the best of all alternatives, satisficing theory contrasts with optimization theory. As Simon formulates, this contrast is analogous to 'looking for the sharpest needle in the haystack' (i.e., optimizing) versus 'looking for a needle sharp enough to sew with' (i.e., satisficing) (Simon, 1987, p. 244).

Let us first describe a satisficing evolutionary dynamics which yields the law of motion of the degree of credulity of the private sector in the policy authorities' commitment (and capacity) to achieve both targets (p^T, y^T) in the relevant future for expectations formation—that is, the proportion of credulous agents, $1 - k$. Consider an agent j who takes the gap between current inflation and the policy inflation target, $p - p^T$, and the gap between current output and the policy output target, $y - y^T$, and then compares what we call the 'policy (in)effectiveness indicator', $(p - p^T)^2 + (y - y^T)^2$, with the policy (in)effectiveness indicator he considers acceptable, $(p^j - p^T)^2 + (y^j - y^T)^2$.[9] We leave exploration of this possibility to future research. If the observed indicator is smaller than or equal to the acceptable indicator, agent j does not consider changing his strategy for forming inflation and output expectations. Otherwise agent j becomes a strategy reviser.

The level of the policy (in)effectiveness indicator that is acceptable or tolerable to a given agent depends, inter alia, on idiosyncratic features which are exogenously determined. We therefore assume that acceptable indicators are randomly and independently determined

[9]Equal weight is attached to deviations from p^T and y^T in these policy (in)effectiveness indicators. This seems the most appropriate starting point for analysis—recall that the credulity and incredulity featuring in equations (4) and (5) are complete, with a private-sector decision maker being credulous or incredulous about the achievements of both policy targets. But unequal weights could be attached should circumstances suggest there exists sufficient behavioural justification. For example, a policy failure to achieve the inflation target may be considered relatively less acceptable than a policy failure to achieve the output target.

across agents and over time. More specifically, we assume that the acceptable level of policy (in)effectiveness, $(p^j - p^T)^2 + (y^j - y^T)^2$, is a random variable with cumulative distribution function $F\colon \mathbb{R}_+ \to [0,1] \subset \mathbb{R}$ which is continuously differentiable. Thus, the probability of randomly choosing a given agent j who considers the current observed policy (in)effectiveness indicator $(p - p^T)^2 + (y - y^T)^2$ as unacceptable is given by:

$$(12) \qquad \Pr((p^j - p^T)^2 + (y^j - y^T)^2 < (p - p^T)^2 + (y - y^T)^2) = F((p - p^T)^2 + (y - y^T)^2),$$

which intuitively increases with any deviation of either the inflation rate or output from their respective targets. Therefore, if the economy achieves both targets (p^T, y^T), we have $F(0) = 0$, so that the measure of agents who consider that the current policy making is not acceptably effective is null.

Meanwhile, the probability that a randomly drawn agent j will consider that the currently observed policy (in)effectiveness indicator is acceptable is simply:

$$(13) \quad \Pr\big((p^j - p^T)^2 + (y^j - y^T)^2 \geq (p - p^T)^2 + (y - y^T)^2\big) = 1 - F\big((p - p^T)^2 + (y - y^T)^2\big)\,.$$

The measure of credulous agents who become incredulous is then given by:

$$(14) \qquad (1-k)\, F((p - p^T)^2 + (y - y^T)^2).$$

Analogously, the measure of incredulous agents who becomes credulous is represented by:

$$(15) \qquad k\left[1 - F\big((p - p^T)^2 + (y - y^T)^2\big)\right].$$

Hence subtracting equation (15) from equation (14) yields the following satisficing evolutionary dynamics:

$$(16) \qquad k = (1-k)\,F((p-p^T)^2 + (y-y^T)^2) \;-\; k\,[\,1 - F((p-p^T)^2 + (y-y^T)^2)].$$

Next, we consider the reasonable possibility that the satisficing evolutionary dynamics in equation (16) operate in the presence of a noise term, analogous to mutation in natural environments. In a biological setting, mutation is interpreted literally as comprising random changes in genetic codes. In economic settings, as interpreted in Samuelson (1997, chap. 7), mutation describes a situation in which a decision maker refrains from comparing payoffs and switches strategy at random. Hence the present specification features mutation as exogenous noise in the satisficing evolutionary protocol, leading a certain proportion of agents to choose an inflation and output foresight strategy at random. This disturbance component is meant to capture the effect of (for instance) exogenous institutional factors, such as changes of administration in the fiscal and monetary authorities, or changes in the policy-making framework other than an abandonment of the inflation and output targeting regime (or the expectation thereof by private agents). When such institutional and administrative changes are more frequent and/or drastic, it is likely that the proportion of mutant agents producing noise in the satisficing evolutionary protocol in equation (16) will be higher. More broadly, political instability or even moderate political changes are likely to be a source of higher proportions of mutant agents. Alternatively, and following Kandori et al. (1993), random choice behaviour can be associated with: an agent exiting the economy with some (fixed) probability, who is then replaced with a new agent who knows nothing about (or is still not sufficiently experienced in) the relevant decision-making process; and/or agents who, for idiosyncratic reasons (from whose determination we abstract), 'experiment' once in a while, with exogenously fixed probability.

Drawing on the specification suggested in Gale et al. (1995), mutation can be incorporated into the satisficing evolutionary dynamics in equation (16) as follows. Let $\varepsilon \in (0,1) \subset \mathbb{R}$ be the measure of mutant agents that choose an inflation and output foresight strategy in a given revision period independently of the respective payoffs. Therefore, there are $\varepsilon(1-k)$ credulous agents and εk incredulous agents behaving as mutants. We assume that mutant agents choose either one or the other of the two inflation foresight strategies with equal probability, so that there are $\varepsilon(1-k)/2$ credulous mutant agents and $\varepsilon k/2$ incredulous mutant agents changing foresight strategy. The net flow of mutant agents becoming incredulous agents in a given revision period, which can be either positive or negative, is then the following:

$$\varepsilon(1-k)\frac{1}{2} \; - \; \varepsilon k\frac{1}{2} = \varepsilon\left(\frac{1}{2}-k\right). \tag{17}$$

Following Gale et al. (1995), this noise can be added to the evolutionary protocol in equation (16) to yield the following *noisy satisficing evolutionary dynamics*:

(18)

$$\dot{k} = (1-\varepsilon)\left\{(1-k)F\left((p-p^T)^2+(y-y^T)^2\right) - k\left[1-F\left((p-p^T)^2+(y-y^T)^2\right)\right]\right\} + \varepsilon\left(\frac{1}{2}-k\right).$$

Equations (7), (9) and (18) constitute an autonomous three-dimensional system of differential equations in which the rates of change of y, p and k depend on the levels of these variables and accompanying parameters. As has been shown, if $k \neq \bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i+\theta_c)}$ and $k \neq \tilde{k}$, it follows from (7) and (9) that $\dot{y}=0$ and $\dot{p}=0$ if, and only if, $y=y^T$ and $p=p^T$. In this case, we have $F(0)=0$ which, inserting this result into (18) and setting $\dot{k}=0$, yields:

$$(1-\varepsilon)\left\{(1-k)F(0)-k[1-F(0)]\right\}+\varepsilon\left(\frac{1}{2}-k\right) = -(1-\varepsilon)k+\varepsilon\left(\frac{1}{2}-k\right)=0. \tag{19}$$

Solving (19) for $k = k^*$ we arrive at:[10]

$$(20) \qquad k = \frac{\varepsilon}{2} \equiv k^*, \text{ with } \varepsilon \neq 2\left[\bar{k} + \frac{\delta\lambda}{\gamma(\theta_i + \theta_c)}\right] \text{ and } \varepsilon \neq 2\tilde{k}.$$

Therefore, the unique equilibrium configuration of the dynamic system represented by (7), (9) and (18) is given by $(y^T, p^T, \frac{\varepsilon}{2})$. In the absence of mutation ($\varepsilon = 0$), the unique equilibrium solution becomes $(y^T, p^T, 0)$. Note that while the equilibrium values of y and p are identical in both cases, the equilibrium distribution of inflation and output foresight strategies depends on whether or not the satisficing evolutionary dynamics is perturbed. In the presence of perturbation represented by mutant agents, the equilibrium solution is characterized by predominance of credulity along the extensive margin ($1 - k \equiv 1 - \frac{\varepsilon}{2} > \frac{1}{2}$), whereas in the absence of this perturbation the equilibrium solution implies full credulity ($k = 0$) along the extensive margin. It is worth noting that the unique equilibrium configuration of the dynamic system represented by (7), (9) and (18) does not feature full incredulity ($k = 1$), whether in the absence of mutation or not. In other words, full incredulity on the part of private-sector decision makers would, intuitively, preclude the very emergence of an equilibrium in which both policy targets are achieved.

Let us now conduct the corresponding stability analysis. The Jacobian matrix of the system (7), (9) and (18) evaluated around the equilibrium $(y^T, p^T, \frac{\varepsilon}{2})$ is given by:

[10] Once again the existence conditions for k^* are 'weak'—there is no behavioural reason to think that the parameters of the model will align so as to violate either of the conditions stated here.

$$J_2 = \left[\begin{array}{c|c|c} a^* & b^* & 0 \\ \hline \alpha b^* & c^* & 0 \\ \hline 0 & 0 & -1 \end{array}\right] \tag{21}$$

where $a^* = -\delta\lambda + \gamma\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2})$, $b^* = \delta[\mu - \Phi(\eta_i, \eta_c, \frac{\varepsilon}{2})]$ and $c^* = (\varphi - \alpha\delta)\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) - \alpha\delta\mu$.

Let ξ be an eigenvalue of the Jacobian matrix (21). We can then set the following characteristic equation of the linearization around the equilibrium:

$$|J_2 - \xi I| = \left|\begin{array}{c|c|c} a^* - \xi & b^* & 0 \\ \hline \alpha b^* & c^* - \xi & 0 \\ \hline 0 & 0 & -1 - \xi \end{array}\right| = -(1 - \xi) \begin{vmatrix} a^* - \xi & b^* \\ \alpha b^* & c^* - \xi \end{vmatrix} = 0. \tag{22}$$

Let $J_1^* = J_1|_{k=\frac{\varepsilon}{2}} = \begin{bmatrix} a^* & b^* \\ \alpha a^* & c^* \end{bmatrix}$, which permits to write the characteristic equation in (22) as follows:

$$-(1 - \xi)\left[\xi^2 - trJ_1^*\xi + detJ_1^*\right] = 0, \tag{23}$$

whose solutions are the eigenvalues of the Jacobian matrix (21), which are given by:

$$\xi_1 = \frac{trJ_1^* + \sqrt{(trJ_1^*)^2 - 4detJ_1^*}}{2}, \xi_2 = \frac{trJ_1^* - \sqrt{(trJ_1^*)^2 - 4detJ_1^*}}{2}, \text{ and } \xi_3 = -1. \tag{24}$$

As $\xi_3 = -1 < 0$, the eigenvalues ξ_2 and ξ_2 determine the stability properties.

Having previously argued that cases of saddle-path instability are mathematical special cases with no compelling behavioural foundations, let us focus hereafter on the cases in Table

1 in which $J_1^* > 0$. We know that $trJ_1^* = 0$ if, and only if,

$$(25) \qquad trJ_1^* = \underbrace{-\delta\lambda + \gamma\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2})}_{a^*} + \underbrace{(\varphi + \alpha\delta)\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) - \alpha\delta\mu}_{c^*} = 0.$$

Given that $\varphi + \alpha\delta > 0$, the condition in expression (25) will be satisfied only if $\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2}) > 0$ or $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) > 0$. Therefore, the condition in expression (25) will be satisfied only if the equilibrium value of the extensive margin of incredulity in the achievement of both official targets, which is given by $k^* = \dfrac{\varepsilon}{2}$, is such that either the net total incredulity in the achievement of the output target or the net total incredulity in the achievement of the inflation target is strictly positive. In other words, it is reasonable to rule out a centre or closed orbit around the equilibrium, because there is no good behavioural reason to think that the parameter configuration required for this dynamic will be observed.

Let us analyse a situation in which the mutation rate ε is sufficiently low, that is, let us assume that $\varepsilon < 2 \min\left\{\bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}, \tilde{k}\right\}$ to ensure that $k^* < \min\left\{\bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}, \tilde{k}\right\}$. Consequently, the equilibrium configuration features $k = k^* < \min\left\{\bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}, \tilde{k}\right\}$ and the economy experiences the cases 1-a, 2-a and 3-a in Table 1, which are characterized by $a^* = -\delta\lambda + \gamma\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2}) < 0$ and $c^* - \alpha b^* = \varphi\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) < 0$. From the latter inequality it follows that $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) < 0$, the substance of which is that the net total incredulity (credulity) in the achievement of the inflation target is strictly negative (positive). For a given ε, intuitively, the inequality given by $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) < 0$ is satisfied if the intensive margin of incredulity in the achievement of the inflation target (η_i) is sufficiently low and/or the intensive margin of credulity in the achievement of the inflation target (η_c) is sufficiently high. As $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) < 0$, we have that $c^* = (\varphi - \alpha\delta)\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) - \alpha\delta\mu < 0$. And with $a^* < 0$ and $c^* < 0$, in turn, it follows that $trJ_1^* < 0$. As a result, if the mutation rate ε is sufficiently low to ensure that $k^* < \min\left\{\bar{k} + \dfrac{\delta\lambda}{\gamma(\theta_i + \theta_c)}, \tilde{k}\right\}$, the equilibrium outcome characterized by $(y^T, p^T, \frac{\varepsilon}{2})$ is a local attractor, and policy makers will succeed in achieving the inflation and output targets.

Let us now analyse a situation in which the mutation rate ε is sufficiently high, so that $\varepsilon > 2\max\left\{\bar{k} + \frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}, \tilde{k}\right\}$, to ensure that $k^* > \max\left\{\bar{k} + \frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}, \tilde{k}\right\}$. The resulting equilibrium configuration features $k = k^* > \max\left\{\bar{k} + \frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}, \tilde{k}\right\}$ and the economy experiences the cases 1-c, 2-b and 3-c in Table 1, which are characterized by $a^* = -\delta\lambda + \gamma\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2}) > 0$ and $c^* - \alpha b^* = \varphi\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) > 0$. From the latter inequality it follows that $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) > 0$, the substance of which is that the net total incredulity (credulity) in the achievement of the inflation target is strictly positive (negative). For a given ε, intuitively, the inequality given by $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) > 0$ is satisfied if the intensive margin of incredulity in the achievement of the inflation target (η_i) is sufficiently high and/or the intensive margin of credulity in the achievement of the inflation target (η_c) is sufficiently low. Considering that $\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) > 0$, the sign of $c^* = (\varphi - \alpha\delta)\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) - \alpha\delta\mu < 0$ is indeterminate, so that a switch in the topological behaviour of the dynamics of the economy may occur. In sum, a sufficiently high mutation rate can, in principle, undermine the stability of the system and the accompanying possibility that two policy targets can be pursued successfully using only one policy instrument.

In order to shed more light on the result just derived, let us now analyse the economic content of one of the possibilities resulting from the assumption that $\varepsilon > 2\max\left\{\bar{k} + \frac{\delta\lambda}{\gamma(\theta_i+\theta_c)}, \tilde{k}\right\}$. Let us take as given all the parameters pertaining to the expectations-augmented aggregate demand schedule in equation (1) and in the expectations-augmented Phillips curve in equation (2), as well as the reaction coefficient λ in the monetary policy rule in equation (3), which indicates the magnitude of the positive response of the nominal interest rate to an increase in output. For a certain configuration of parameters measuring the intensive margins of incredulity and credulity in the achievement of the official inflation and output targets given by $(\eta_i, \eta_c, \theta_i, \theta_c)$, let μ_f be the bifurcation point from the achievement of which it follows that $J_1|_{k=\frac{\varepsilon}{2}} = \gamma\Psi(\theta_i, \theta_c, \frac{\varepsilon}{2}) + (\varphi - \alpha\delta)\Phi(\eta_i, \eta_c, \frac{\varepsilon}{2}) - \delta(\lambda + \alpha\mu_f) = 0$. Since $\frac{\partial tr J_1^*}{\partial \mu_f} = -\delta\alpha < 0$, it then follows that for $\mu < \mu_c$ we have that $J_1^* > 0$. Therefore, if the magnitude of the positive response of the nominal interest rate to a strictly positive gap between the current and the target for inflation is such that $\mu < \mu_f$, the equilibrium $(y^T, p^T, \frac{\varepsilon}{2})$ becomes locally unstable. In other words, even with ε large, stability can be achieved through a recognizable policy behaviour: a sufficiently strong reaction of the central bank to a situation where inflation departs from its target value. Note that this result connects to the spirit of the Taylor principle in mainstream macroeconomic models, according to which the nominal interest rate should be raised more than one-for-one to reduce aggregate spending when inflation increases, so that the real interest rate rises as well. Note also that the second reaction coefficient in the monetary policy rule, λ, can also be treated as a bifurcation parameter. Hence the result just derived can be generalized to state that, even with ε large, we observe stability as long as the central bank's response to out-of-equilibrium states is sufficiently strong *somewhere* in its 'dual mandate' reaction function.

5 Conclusion

According to Lima et al. (2014), when private decision makers formulate heterogeneous inflation expectations and switch between them on the basis of satisficing evolutionary dynamics, macro stabilization policy can succeed even when policy makers use fewer (formal) policy instruments than they have targets (thus appearing to violate the Tinbergen principle). This result holds even without the complete anchoring of expectations to policy makers' targets, and even when the dynamics that guide switching between forecasting heuristics are noisy. In short, the dynamics of switching between heterogeneous forecasting strategies in the private sector emerges as a pseudo policy tool that is conducive to macroeconomic stabilization. In this paper, we have further explored the robustness of this key result by introducing output (as well as inflation) expectations, allowing for 'intensive' margins of credulity and incredulity and hence gradable degrees of commitment to (or scepticism towards) policy makers' targets, and making the revision of expectations an increasing function of any gap that arises between actual outcomes and their target values. Our results show that even in the presence of these extensions, evolving heterogeneous expectations can contribute to macroeconomic stability, enabling policy makers to successfully pursue two policy targets with one policy instrument.

Even in the absence of imitation effects,[11] our results do reveal potential sources of instability.[12] This is not, in and of itself, surprising, given that we have added more (interrelated) structure to the model so that there are now more forces and mechanisms at play. More specifically, the assumed form of incredulity is now 'harder' and thus potentially more disruptive, and there are more sources of incredulity, associated with output as well as inflation targeting, and an intensive margin that allows for gradable degrees of commitment to (or scepticism towards) any given target. In this new environment, potential sources of instability uncovered by our analysis include the requirement that some asymmetry must exist among the various intensive and extensive margins of (in)credulity—which does not appear to represent an exacting behavioural requirement—and, when there is endogenous variation in the extensive margin of incredulity ($\dot{k} \neq 0$) in accordance with noisy satisficing evolutionary dynamics, that the measure of mutant agents that choose an inflation and output foresight strategy independently of the respective payoffs, ε, is sufficiently low.

This last requirement merits some further reflection. First, it implies that ideally, switching between forecasting strategies should be sufficiently focused on the current achievement of policy targets, and not become dominated by 'extraneous' factors such as uncertainty regarding organizational changes and/or personnel. In other words, because potential instability problems arising from $\dot{k} \neq 0$ can be associated with the size of ε, policy makers should avoid creating

[11]Recall that, as previously noted, imitation is identified as a potentially destabilizing force in Lima et al. (2014).

[12]Recall also that *some* expected change in inflation is required for the existence and uniqueness of equilibrium although as previously remarked, the absence of such change does not have compelling behavioural foundations.

uncertainty among private decision makers above and beyond that already associated with the credulity of policy targets. Second, the fact that problems associated with the size of ε do not exist if $\dot{k} = 0$ invites interpretation of the reduced dimensionality of the model in section 3 as reflecting *faster and slower moving dynamics* within the system—specifically, policy intervention that is fast relative to the evolution of expectation formation strategies within the private sector.[13] On this interpretation, our results in section 3 suggest that value attaches to *timely* policy intervention—intervention that is sufficiently quick and decisive to stabilize the economy before potentially complicating dynamics associated with the dynamics of forecasting strategies take effect.[14] Put differently, slow and indecisive policy making risks giving rise to sources of instability that could have been avoided by quicker and more decisive intervention.

One factor that may assist policy makers in this regard is the fact that within the private sector, forming expectations and then subsequently making and implementing decisions predicated on these expectations takes time. Set against this, however, is the fact that real-world policy authorities confront informational constraints themselves, that make deliberation (and the time it takes) valuable.[15] Model uncertainty can affect the efficacy of stabilization policy and should elicit caution in its implementation.[16] At the same time, uncertainty about the current and future state of the macroeconomic environment means that value attaches to the opportunities for learning that the passage of time affords. Hence exercising the opportunity to wait before implementing policy may prove wise. In all cases, it appears that relative speeds of adjustment in decision making processes are important. Perhaps the surest conclusion that can be reached

[13] Policy makers may be helped in this regard if $\dot{k}$ is endogenous, such that the evolution of the distribution of forecasting strategies is slowed down by (for example) successful communication strategy, giving policy makers more time to implement policy intervention without simultaneously having to contend with variation of k.

[14] It will immediately be recognized that this dovetails with ongoing debates surrounding the speed and/or timidity of policy interventions. See, for example, Rudebusch (2001) and, more recently, Cochrane (2022) with reference to the conduct of monetary policy in the US.

[15] It is also important to remember that policy intervention can be effective even when the dynamics of stabilization policy and heterogeneous expectations adjustment operate contemporaneously, as long as the role of ε in the latter does not become too large.

[16] See, for example, Setterfield (2018).

on the basis of these reflections is that ultimately, an element of context-specific judgement remains an important component of successful stabilization policy.

A Appendix: Derivation of equation (5)

Equation (5) is derived as follows. We suppose that the private sector varies its expectations with respect to the course of a deviation of current output from its official target in a direction and magnitude that depends on the level of such a deviation. For a given strictly positive or negative deviation of current output from its official target, the expected rate of change of this deviation is determined by the expected rate of change of output and the expected rate of change of the output target. We assume that the private sector sees the official output target as being determined exogenously by the monetary policy makers and does not expect it to change (for reasons from which we abstract) in the course of the relevant future for its expectation formation, which means that the expected rate of change of the output target is equal to zero.[17]

Therefore, the rate of change of the expectation of the private sector about the course of a given strictly positive or negative deviation of current output from its official target is determined by the expected rate of change of output. The expected rate of change of output is a weighted average of incredulous agents' expected rate of change of output ($\dot{y}_i^e$) and credulous agents' expected rate of change of output ($\dot{y}_c^e$): that is, $\dot{y}^e = k\dot{y}_i^e + (1-k)\dot{y}_c^e$. As in Lima et al. (2014), credulous agents expect the (full or at least partial) convergence of current output to the policy target, y^T, in the relevant future for such an expectation formation. However, differently from Lima et al. (2014), incredulous agents expect output to further deviate from the target

[17]Analogously to our related assumption about the expected change in the inflation target on the part of private-sector decision makers, it is possible that a gap $y - y^T \neq 0$ is seen as being so large that they expect policy makers to change the official output target. It is also possible that policy makers announce a higher output target, but incredulous agents believe that this target is not achievable due to structural constraints. We leave exploration of these and other related possibilities to future research.

unless the target has already been achieved (a stronger kind of "incredulity of Saint Thomas"), so we formally have $\dot{y}^e_c = -\theta_c(y - y^T)$ and $\dot{y}^e_i = \theta_i(y - y^T)$, recalling that $\theta_c \in (0,1] \subset \mathbb{R}$ and $\theta_i \in [0,\infty) \subset \mathbb{R}$ are parametric constants. In other words, a credulous agent expects that the deviation represented by $y - y^T$ will be at least partially (or, when $\theta_c = 1$, even fully) reduced, while an incredulous agent expects that this gap will remain unchanged only when it is equal to zero (i.e., when the output target has been achieved), or when $\theta_i = 0$. The gap is expected to rise monotonically otherwise.[18]

Therefore, it is only when the output target has been achieved, or when $\theta_i = 0$, that an incredulous agent does not expect a change in output. In particular, any strictly positive or negative gap denoted by $y - y^T$ is expected by an incredulous agent to vary further by $\theta_i \left|y - y^T\right|$, the reason being that the expected change in that gap by an incredulous agent is given by $E_\tau\left[\frac{d(y-y^T)}{dt}\right] = E_\tau\left[\frac{dy}{dt}\right] - E_\tau\left[\frac{dy^T}{dt}\right] = \dot{y}^e_\tau$, recalling that the private sector expects the output target to remain unchanged, so that $E_\tau\left[\frac{dy^T}{dt}\right] = 0$ for $\tau = c, i$. Substituting the expressions for $\dot{y}^e_c$ and $\dot{y}^e_i$ stated above into the expression for $\dot{y}^e$ as previously stated yields equation (5).

The function $\Psi(\theta_i, \theta_c, k) \equiv k\theta_i - (1-k)\theta_c$ in equation (5) is a composite coefficient denoting the adjustment of the expected output to a non-null output gap interpreted as $y - y^T$. If $\Psi(\theta_i, \theta_c, k) < 0$ ($\Psi(\theta_i, \theta_c, k) > 0$), given the intensity of incredulity and credulity represented by θ_i and θ_c, respectively, the extensive margin of incredulity with respect to the achievement of the output target represented by k is relatively low (high), so that the weighted average of the expected rate of change of output in equation (5), represented by $\dot{y}^e = k\dot{y}^e_i + (1-k)\dot{y}^e_c$, will have the opposite sign of (same sign as) the output gap represented by $y - y^T$. Or, given the extensive margins of incredulity and credulity represented by k and $1-k$, respectively, the

[18] Therefore, similarly to their behaviour with respect the official inflation target, incredulous agents are incredulous about the prospect of achieving the output target, but not about the prospect of maintaining such an achievement. Meanwhile, an extreme incredulity stance would be to expect that the output target will not remain being achieved even if it happens to be achieved in a given moment in time. We abstract from this extreme incredulity stance and leave the exploration of its analytical implications to future research.

intensity of incredulity (credulity) with respect to the achievement of the output target, which is given by θ_i (respectively θ_c) is relatively low (high), so that the weighted average of the rate of change of expected inflation in equation (5) will have the opposite sign of (same sign as) the gap denoted by $y - y^T$.

Therefore, the composite coefficient $\Psi(\theta_i, \theta_c, k)$ measures the net total incredulity in the achievement of the output target, so that when $y - y^T > 0$, it follows that $\dot{y}^e > 0$ ($\dot{y}^e < 0$) if $\Psi(\theta_i, \theta_c, k) > 0$ ($\Psi(\theta_i, \theta_c, k) < 0$). In fact, let $\bar{k} \equiv \dfrac{\theta_c}{\theta_i + \theta_c} \in (0, 1] \subset \mathbb{R}$ be the critical value of the extensive margin of incredulity in the achievement of the output target resulting in $\Psi(\theta_i, \theta_c, \bar{k}) = 0$. Since $\dfrac{\partial \Psi}{\partial k} = \theta_i + \theta_c > 0$, we have that $\Psi(\theta_i, \theta_c, k) < 0$ when $0 \leq k < \bar{k}$, while $\Psi(\theta_i, \theta_c, k) > 0$ when $\bar{k} < k \leq 1$. Given that $\lim_{\theta_i \to \infty} \bar{k} = 0$, it follows that for levels of intensity of incredulity sufficiently high we have that $\Psi(\theta_i, \theta_c, k) > 0$ no matter how low (yet strictly positive) the extensive margin of incredulity k happens to be. Also—and as might reasonably be expected—the combination of intensity of incredulity and credulity in the achievement of the output target that is most favorable to stabilization policy, represented by $(\theta_i, \theta_c) = (0, 1)$, results in $\bar{k} = 1$. In this benign case, we necessarily have that $\Psi(\theta_i, \theta_c, k) < 0$ for any $k \in [0, 1) \subset \mathbb{R}$, that is, the net total incredulity (credulity) in the achievement of the output target is negative (positive) and hence works in an output-gap-reducing manner. In fact, note that the function $\Psi(\theta_i, \theta_c, k)$ takes its minimum value when the intensity of incredulity (credulity) is the lowest (highest), that is, $\Psi(0, 1, k) = -(1 - k)$. More broadly, we have that $\Psi(\theta_i, \theta_c, 1) = \theta_i$ and $\Psi(\theta_i, \theta_c, 0) = -\theta_c$ are, respectively, the maximum and minimum value of the function $\Psi(\theta_i, \theta_c, k)$ for any given combination (θ_i, θ_c).

Consequently, the expected rate of change of output depends not only on the deviation of output from its official target and the frequency distribution of expectation-formation strategies in the private sector—which measures the extensive margin of (in)credulity in the achievement of the output target—but also on both the intensity of incredulity and credulity θ_i and θ_c, respectively. Given the proportion of incredulous and credulous agents in the private sector, the net total incredulity (credulity) in the achievement of the output target falls (increases) along the intensive margin as θ_i (respectively θ_c) tends to zero (one), since $\frac{\partial \Psi}{\partial \theta_i} = k > 0$ and $\frac{\partial \Psi}{\partial \theta_c} = -(1-k) < 0$. Besides, note that $\Psi(\theta_i, 0, k) \equiv k\theta_i > 0$ is the maximum value taken by the net total incredulity if the respective intensity of incredulity is finite, whereas $\lim_{\theta_i \to \infty} \Psi(\theta_i, \theta_c, k) = \infty$ for any $\theta_c \in (0, 1] \subset \mathbb{R}$ and $k \in (0, 1] \subset \mathbb{R}$. Thus, no matter how low (yet strictly positive) the extensive margin of incredulity k, the net total incredulity tends to infinity if the respective intensity of incredulity tends to infinity. Meanwhile, given the intensity of incredulity (θ_i) and credulity (θ_c), the net total incredulity (credulity) in the achievement of the official output target increases along the extensive margin as k tends to one (zero).

References

Apokoritis, N., Galati, G., and Moessner, R. (2025). Inflation expectations anchoring: New insights from microevidence of a survey at high frequency and of distributions. International Journal of Central Banking, 21(1):201–234.

Baumann, U., Ferrando, A., Georgarakos, D., Gorodnichenko, Y., and Reinelt, T. (2025). Do inflation expectations become more anchored during a disinflation episode? Evidence for euro area firms. Working Paper 33440, National Bureau of Economic Research.

Carvalho, C., Eusepi, S., Moench, E., and Preston, B. (2023). Anchored inflation expectations. American Economic Journal: Macroeconomics, 15(1):1–47.

Chamley, C. P. (2004). Rational Herds: Economic Models of Social Learning. Cambridge University Press.

Cochrane, J. H. (2022). Inflation past, present and future: Fiscal shocks, Fed response, and fiscal limits. Working Paper 30096, National Bureau of Economic Research.

Gale, J., Binmore, K. G., and Samuelson, L. (1995). Learning to be imperfect: The ultimatum game. Games and Economic Behavior, 8(1):56–90.

Hommes, C. (2011). The heterogeneous expectations hypothesis: Some evidence from the lab. Journal of Economic Dynamics and Control, 35(1):1–24.

Hommes, C. (2021). Behavioral and experimental macroeconomics and policy analysis: A complex systems approach. Journal of Economic Literature, 59(1):149–219.

Kandori, M., Mailath, G. J., and Rob, R. (1993). Learning, mutation, and long run equilibria in games. Econometrica, 61(1):29–56.

Keynes, J. M. (1936). The General Theory of Employment, Interest and Money. Macmillan and Co., Ltd., London.

Lima, G. T., Setterfield, M., and Silveira, J. J. (2014). Inflation targeting and macroeconomic stability with heterogeneous inflation expectations. Journal of Post Keynesian Economics, 37(2):255–279.

Lima, G. T., Setterfield, M., and Silveira, J. J. (2025). Achieving two policy targets with one policy instrument: heterogeneous expectations, countercyclical fiscal policy, and macroeconomic stabilization at the effective lower bound. Review of Evolutionary Political Economy, 6(1):135–155.

Naggert, K., Rich, R. W., and Tracy, J. (2023). The anchoring of us inflation expectations since 2012. Federal Reserve Bank of Cleveland Economic Commentary, 2023(11):1–7.

Rudebusch, G. D. (2001). Is the Fed too timid? Monetary policy in an uncertain world. The Review of Economics and Statistics, 83(2):203–217.

Samuelson, L. (1997). Evolutionary Games and Equilibrium Selection. MIT Press, Cambridge, MA.

Setterfield, M. (2009). Macroeconomics without the LM curve: an alternative view. Cambridge Journal of Economics, 33(2):273–293.

Setterfield, M. (2018). Can monetary policy survive policy model mis-specification? Model uncertainty and the perils of "policy model complacency". Metroeconomica, 69(1):2–15.

Simon, H. A. (1955). A behavioral model of rational choice. Quarterly Journal of Economics, 69(1):99–118.

Simon, H. A. (1956). Rational choice and the structure of the environment. Psychological Review, 63(2):129–138.

Simon, H. A. (1987). Satisficing. In Eatwell, J., Milgate, M., and Newman, P. K., editors, The New Palgrave: A Dictionary of Economics, volume 4. Macmillan / Stockton Press, New York.