Time inconsistency and monetary policy

Karl Harmenberg*

2025

This note introduces the time-inconsistency problem in the context of monetary policy as well as a discussion of central bank independence and inflation targeting. The note is prepared for master students in economics at the University of Oslo, although it is at least in principle accessible to anyone comfortable with Lagrangians.

1 Introduction

How should we design the institutions of monetary policy? One could easily imagine that the best we could hope for is a central bank governor/decision maker who at every time understands the functioning of the economy and, rationally and exactly, chooses the optimal policy for society as a whole, weighing the costs and benefits of each policy option. It may seem unrealistic, given both cynical political dynamics and our current understanding of the economy, to hope for such a god-like central bank governor. However, surely we can all agree that if we could design our institutions such that a benevolent and in every way perfect central bank governor *is* appointed and chooses the optimal policy at every point in time, then we would be in the utopian best-case scenario.

Surprisingly, this is *not* the best-case scenario and in fact quite far from it. Explaining why is the main goal of this note. The reason is that the central bank faces a *time inconsistency problem.* The gist of the insight can be understood by analogy to patents. Patents, i.e., the exclusive rights to an invention for a period of time, incentivize firms to invest in research and development. The *expectations* of future profits induce research today. Pharmaceutical companies are willing to spend billions developing a new drug, in the hope of recouping the costs through future sales. However, once the drug is developed and approved, the government faces a temptation. If the government reneges on its promise of patent protection and instead produces and sells the drug cheaply, more individuals can be treated and helped by the new drug. This temptation means that the government faces a *time-inconsistency problem.* It is optimal, ex ante, to have a

*I thank without implicating Steinar Holden and Erik Öberg for interesting discussions.

patent system protecting monopoly rights for innovations, inducing costly research and development. However, ex post, it is optimal to renege on the patent protection and produce the drug cheaply.

In a wide class of models, reflecting our best understanding of the economy, optimal monetary policy is *time inconsistent*. In the example we develop below, inflation today depends on output today and expectations of future inflation. The central bank wants to stimulate the economy today but promise low inflation in the future, thereby keeping inflation moderate today despite the stimulus. That is, the central bank wants to stimulate the economy today but promise to not stimulate the economy tomorrow. However, once tomorrow arrives, the central bank wants to stimulate the economy tomorrow, promising not to stimulate the economy the day after tomorrow, and so on. The central bank thus faces a time-inconsistency problem. If the public understands this and correctly anticipates the central bank's behavior, then expectations of future inflation will be high, feeding back to current inflation. As a result, seemingly paradoxically, a god-like central bank governor choosing optimal policy at every point in time is far from optimal. Instead, we find that *commitment* to a policy rule (e.g., strict inflation targeting) outperforms the *discretion* of a god-like central bank governor.

Literature The key idea (Kydland and Prescott, 1977) was developed by Kydland and Prescott while Finn Kydland was working at NHH and Edward Prescott was visiting him in Bergen. The paper was published in 1977 and earned them, together with another landmark paper of theirs (Kydland and Prescott, 1982), the Nobel Prize in Economics in 2004. Another central paper of the early literature is Barro and Gordon (1983). For further reading and an introduction to the literature, the Advanced Background of the 2004 Nobel Prize in Economics is a good starting point (The Royal Swedish Academy of Sciences, 2004).

I develop their argument using a *new-Keynesian Phillips curve*, a central ingredient of current monetary theory. To understand the microfoundations of the new-Keynesian Phillips curve, you are encouraged to study Galí (2015) (see also Clarida et al. (1999), in particular section 4). However, if you are willing to take the new-Keynesian Phillips curve as given, then this note is self-contained.

The time inconsistency of monetary policy is a major reason to set up institutions such that the central bank is committed to a policy rule, in particular to inflation targeting. Another, and complementary, reason is to insulate policy making from political pressure to stimulate the economy in order to gain public opinion. For a textbook treatment of the political dimensions of macroeconomic policy, see Persson and Tabellini (2005).

The time-inconsistency problem is a prime application of modern dynamic macroeconomic theory from the last fifty years, commonly associated with the terms *rational expectations* and the *Lucas critique* (Lucas, 1976). In this paradigm, expectations are central for macroeconomic analysis and it is maintained that the public, at least partially, form their expectations based on how the government *will* behave. As a result, the relation between, e.g., inflation and output depends on the conduct of policy.

Finally, the potential value of commitment is an insight with many applications in the social sciences. See Schelling (1960) for a classic treatment of the value of commitment more broadly, through the lens of game theory.

2 Model

A central planner (which we may think of as the central bank) wants low inflation π_t and high output y_t (relative to a "natural level of output", normalized to 0). Concretely, the planner faces the following maximization problem:

$$\max_{\{\pi_t, \mathbb{E}_t \pi_{t+1}, y_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left(-\frac{(y^* - y_t)^2}{2} - \omega \frac{\pi_t^2}{2} \right). \tag{Objective}$$

The planner discounts future welfare at a rate β. She has a target output level $y^* > 0$, a target inflation level $\pi^* = 0$, and a quadratic loss function with weight ω on inflation. With higher ω, the planner puts more weight on inflation. The planner chooses inflation π_t, expected inflation $\mathbb{E}_t \pi_{t+1}$, and output y_t directly (we thus abstract from the exact mechanisms through which the central bank stimulates the economy, e.g., through interest rates or other monetary policy instruments).

The planner faces two restrictions. First, a trade-off between inflation π_t, expected inflation $\mathbb{E}_t \pi_{t+1}$, and output y_t captured by a *new-Keynesian Phillips curve*,

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \kappa y_t. \tag{New-Keynesian Phillips curve}$$

The parameter β is the same discount factor as in the objective function, and $\kappa > 0$ is the slope of the Phillips curve. Inflation today depends on output today, but also on expected future inflation. If the planner could choose expected future inflation $\mathbb{E}_t \pi_{t+1}$ freely, then this tradeoff would be easy: choose that the public expects low inflation tomorrow ($\mathbb{E}_t \pi_{t+1}$) so that both low inflation and high output can be implemented.

However, we envision a world in which the planner cannot choose $\mathbb{E}_t \pi_{t+1}$ freely. Expected inflation tomorrow depends on how the public imagines that policy will be conducted tomorrow. Although perhaps a sly planner may be able to fool the public occasionally, we rule out such deception. Instead, the second constraint which the planner faces is in the form of rational expectations. Under rational expectations, which in this simple setting is equivalent to perfect foresight, the public's expectations $\mathbb{E}_t \pi_{t+1}$ equals actual π_{t+1}, so the planner cannot exploit expectational errors,

$$\mathbb{E}_t \pi_{t+1} = \pi_{t+1}. \tag{Rational expectations}$$

That is, the only way to make the public believe that there will be low inflation tomorrow is to actually implement low inflation tomorrow. Through the endogenous expectations of the public, the planner's problem is dynamic: expectations about tomorrow feed back into the planner's problem today.

Note that the planner can easily implement $y_t = \pi_t = \mathbb{E}_t \pi_{t+1} = 0$ for all $t \geq 0$ given the constraints given by the new-Keynesian Phillips curve and rational expectations. If the target output level was equal to 0, $y^* = 0$, there would thus not be a tradeoff between inflation and output and the ideal policy would simply be zero inflation at all times. However, since the planner desires an output beyond the "natural level of output", $y^* > 0$, the planner's problem consists of a non-trivial tradeoff between inflation and output. The planner will be willing to induce a bit of inflation in order to push output beyond its "natural level".

Finally, note that this stylized model leaves out many dimensions relevant to monetary policy. In particular, we assume an unrealistically tranquil macroeconomic environment: there are no shocks to the economy which motivate cyclical stabilization policy. The results below should therefore be understood as showing an important dimension of policy, not a complete assessment.

2.1 Commitment

The maximization of the planner's objective function subject to the Phillips curve and rational expectations is a well-defined mathematical optimization problem. In this subsection, we solve this optimization problem.

We call the setting *commitment* since the planner commits to π_t and y_t for all $t \geq 0$ at time $t = 0$. By contrast, in Subsection 2.2 we study *discretion*, where the planner only chooses policy for time t at time t without being able to commit to any future policies.

2.1.1 Optimal policy under commitment: the mathematics

Substituting π_{t+1} for $\mathbb{E}_t \pi_{t+1}$ in the Phillips curve, the Lagrangian for the optimization problem is given by

$$\mathcal{L} = \sum_{t=0}^{\infty} \beta^t \left(-\frac{(y^* - y_t)^2}{2} - \omega \frac{\pi_t^2}{2} \right) + \sum_{t=0}^{\infty} \lambda_t \left(\pi_t - \beta \pi_{t+1} - \kappa y_t \right).$$

with λ_t as the Lagrange multiplier on the Phillips-curve constraint. The first-order conditions are:

$$\begin{aligned}
\partial y_t : &\quad \beta^t (y^* - y_t) - \kappa \lambda_t = 0, & \\
\partial \pi_t : &\quad -\omega \beta^t \pi_t + \lambda_t - \beta \lambda_{t-1} = 0, & (t > 0) \\
\partial \pi_0 : &\quad -\omega \pi_0 + \lambda_0 = 0. & (t = 0)
\end{aligned}$$

(note that $t = 0$ is special since π_0 only shows up in one constraint)

Putting the FOCs together, we get

$$\begin{aligned}
\lambda_t &= \frac{\beta^t (y^* - y_t)}{\kappa}, \\
0 &= -\omega \beta^t \pi_t + \frac{\beta^t (y^* - y_t)}{\kappa} - \beta \frac{\beta^{t-1} (y^* - y_{t-1})}{\kappa} \Leftrightarrow \\
\pi_t &= -\frac{\Delta y_t}{\kappa \omega} \qquad t > 0 \qquad (1)
\end{aligned}$$

Finally, the initial period, $t = 0$, is special and yields the first-order condition $\pi_0 = \frac{y^* - y_0}{\kappa \omega}$.

Substituting Equation (1) into the Phillips curve, we get

$$\Delta y_t = \beta \Delta y_{t+1} - \kappa^2 \omega y_t \Leftrightarrow$$
$$0 = y_{t+1} - \frac{1+\beta+\kappa^2\omega}{\beta} y_t + \frac{1}{\beta} y_{t-1}$$

This is a second-order difference equation and its solution is a standard procedure (see Sydsæter et al. (2008), chapter 11, section 4). Solving the difference equation yields two characteristic roots: one root is greater than 1 and the other is less (in absolute value) than 1. All bounded solutions are associated with the smaller root.[1] The solution to the difference equation is

$$y_t = \rho^t y_0 \qquad \text{with} \qquad \rho = \frac{1+\beta+\kappa^2\omega}{2\beta} - \sqrt{\left(\frac{1+\beta+\kappa^2\omega}{2\beta}\right)^2 - \frac{1}{\beta}}$$

where we have left to determine the value of y_0. Note that the Phillips curve can be solved forward to obtain $\pi_0 = \kappa \sum_{t=0}^{\infty} \beta^t y_t$.[2] Thus $\pi_0 = \kappa \sum_{t=0}^{\infty} (\beta\rho)^t y_0 = \frac{1}{1-\rho\beta} \kappa y_0$. Putting this together with the optimality condition for π_0 yields $y_0 = \frac{1}{1+\frac{\kappa^2\omega}{1-\beta\rho}} y^*$.

Optimal policy under commitment is thus given by

$$y_t = \rho^t \frac{1-\beta\rho}{1-\beta\rho+\kappa^2\omega} y^*,$$
$$\pi_t = \rho^t \frac{\kappa}{1-\beta\rho+\kappa^2\omega} y^*.$$

[1] The difference equation has characteristic polynomial

$$0 = \rho^2 - \frac{1+\beta+\kappa^2\omega}{\beta}\rho + \frac{1}{\beta}.$$

The roots are given by

$$\rho = \frac{1+\beta+\kappa^2\omega}{2\beta} \pm \sqrt{\left(\frac{1+\beta+\kappa^2\omega}{2\beta}\right)^2 - \frac{1}{\beta}}$$

Note that $\left(\frac{1+\beta+\kappa^2\omega}{2\beta}\right)^2 - \frac{1}{\beta} = \left(\frac{1-\beta}{2\beta}\right)^2 + \left(\frac{\kappa^2\omega}{2\beta}\right)^2 + \frac{(1+\beta)\kappa^2\omega}{2\beta^2} > \left(\frac{1-\beta}{2\beta}\right)^2$. In particular, the term inside the square root is positive, so both roots are real. Further, it is immediate that both roots are positive. The larger root is greater than 1 since

$$\frac{1+\beta+\kappa^2\omega}{2\beta} + \sqrt{\left(\frac{1+\beta+\kappa^2\omega}{2\beta}\right)^2 - \frac{1}{\beta}} > \frac{1+\beta}{2\beta} > 1.$$

The smaller root is smaller than 1 if and only if $2\frac{1+\beta+\kappa^2\omega}{2\beta} - 1 > 1/\beta$ which is evidently true (note that $A - \sqrt{A^2 - B} < 1$ if and only if $2A - 1 > B$ for $A > 1$).

We thus have one explosive and one non-explosive root and the only non-exploding solution to the difference equation is given by $y_t = \rho^t y_0$ where $\rho = \frac{1+\beta+\kappa^2\omega}{2\beta} - \sqrt{\left(\frac{1+\beta+\kappa^2\omega}{2\beta}\right)^2 - \frac{1}{\beta}}$ is the smaller root.

[2] Expand as follows: $\pi_0 = \kappa y_0 + \beta\pi_1 = \kappa y_0 + \beta(\kappa y_1 + \beta\pi_2) = \kappa y_0 + \beta(\kappa y_1 + (\beta\kappa y_2 + \ldots)) = \kappa \sum_{t=0}^{\infty} \beta^t y_t$.

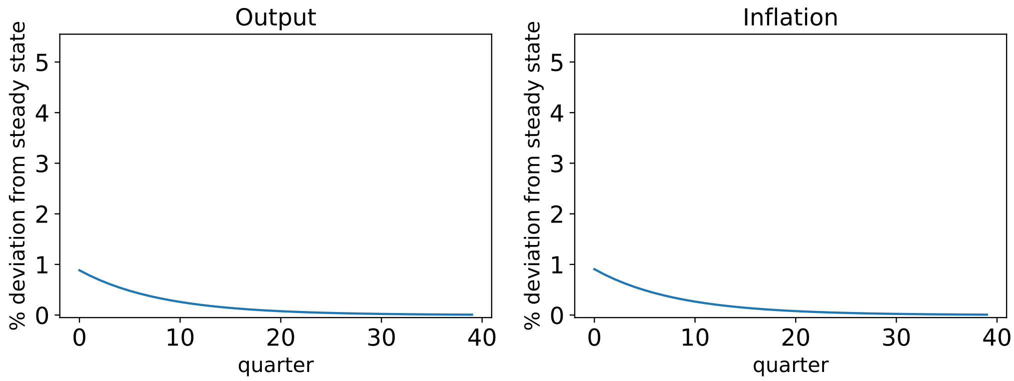

Figure 1: The optimal path of output and inflation under commitment. The planner stimulates the economy initially but gradually reduces the stimulus to zero.

2.1.2 Optimal policy under commitment: the interpretation

Optimal policy: one-off stimulus Figure 1 shows the optimal path of output and inflation under commitment, using Galí (2015)'s quarterly calibration of the new-Keynesian Phillips curve and $\omega = 1$. The optimal policy is to stimulate the economy a bit initially, boosting output and employment. This stimulus comes at the cost of temporary higher inflation. However, if the planner would stimulate the economy for a long period, this would result in much too high inflation. Why? Inflation today depends on expected inflation tomorrow, which in turn depends on the expected inflation the day after tomorrow, and so on. Because of the forward-looking expectations, stimulus in the future feeds back into higher inflation today. Permanent stimulus such that output is y for all time periods would result in inflation at time 0 equal to $\pi_0 = \kappa(\underbrace{y}_{\text{today}} + \underbrace{\beta y}_{\text{tomorrow}} + \underbrace{\beta^2 y}_{\text{day after tomorrow}} + \cdots) = \kappa \frac{y}{1-\beta}$.

Time inconsistency Now, here is the crux: let's say that the central planner uses this plan until period $t = 10$. At period $t = 10$, he computes the optimal plan from $t = 10$ and onward. The economic environment is time invariant, so the optimal policy at time $t = 10$ is identical to the optimal policy at time $t = 0$. I.e., it is optimal to engineer a short lived boom and then promise zero inflation in the future.

This is a profound issue: the central planner faces *time inconsistency.* The optimal policy, which the planner would like to commit to at time $t = 0$, is not the optimal policy from the perspective of time $t = 10$. The planner thus, rationally, would like to break his promise at time $t = 10$, in order to maximize welfare. If the central planner cannot commit at time $t = 0$ to not renege on his plan at time $t = 10$, then the commitment is not credible.

2.2 Discretion

Recognizing the time-inconsistency problem, it may be too much to hope that the planner can choose a plan and stick to it over time. Under *discretion*, the central planner only chooses policy for time t at time t without being able to commit to any future policies. One game-theoretic way to understand the problem is as follows. If we view the policy problem as a *game* between the planner at time 0, the planner at time 1, and so on, where each planner cares about welfare from her own time period and forward, then the optimal policy outlined above is not a *Nash equilibrium.* We now solve the outcome under discretion, i.e., for the Nash equilibrium of the game.

Optimal policy under discretion: the mathematics In this setting, the planner at time t faces the optimization problem:

$$\max_{\pi_t, y_t} -\frac{(y^* - y_t)^2}{2} - \omega\frac{\pi_t^2}{2} \qquad \text{subject to} \qquad \begin{aligned} \pi_t &= \beta\mathbb{E}_t\pi_{t+1} + \kappa y_t, \\ \mathbb{E}_t\pi_{t+1} &= \pi_{t+1}. \end{aligned}$$

Note that we are only choosing π_t and y_t, not π_{t+1} or $\mathbb{E}_t\pi_{t+1}$ which we take as given. In other words, the current planner treats next period's expected inflation as an external input, determined by the future planner's actions, not something it can influence today. Note also that the planner may care about subsequent periods' welfare, but since this welfare does not depend on the choice of π_t and y_t, it makes no difference for the planner's maximization problem.

In the homework below, you will solve this optimization problem for all periods $t \geq 0$ and show that the resulting output and inflation are given by

$$\begin{aligned} y_t &= \frac{1-\beta}{1-\beta+\kappa^2\omega}y^*, \\ \pi_t &= \frac{\kappa}{1-\beta+\kappa^2\omega}y^*. \end{aligned}$$

Homework 1 *In this homework exercise, we solve the planner's discretionary problem. The planner's discretionary problem is as follows, note that the planner does not choose* $\mathbb{E}_t\pi_{t+1}$ *or* π_{t+1} *but takes them as given.*

$$\max_{\pi_t, y_t} -\frac{(y^* - y_t)^2}{2} - \omega\frac{\pi_t^2}{2} \qquad \textit{subject to} \qquad \begin{aligned} \pi_t &= \beta\mathbb{E}_t\pi_{t+1} + \kappa y_t, \\ \mathbb{E}_t\pi_{t+1} &= \pi_{t+1}. \end{aligned}$$

1. *Take the first-order conditions for the planner's problem in period t and show that they reduce to*

$$y_t = y^* - \kappa\omega\pi_t. \qquad \text{(FOC)}$$

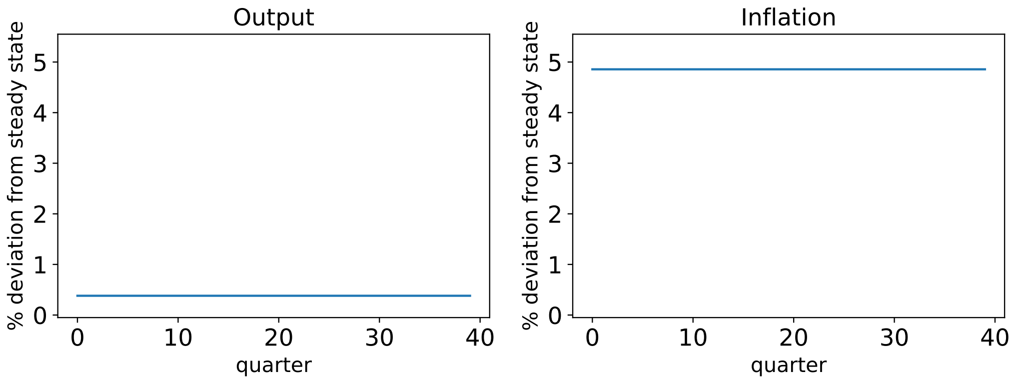

Figure 2: The optimal path of output and inflation under discretion. The planner stimulates the economy constantly.

2. *Plug the FOC into the Phillips curve and show that the dynamics of inflation are given by*

$$\pi_t = \frac{\beta}{1+\kappa^2\omega}\pi_{t+1} + \frac{\kappa}{1+\kappa^2\omega}y^* \qquad \text{(Inflation dynamics)}$$

3. *Use* $\pi_{t+1} = \frac{\beta}{1+\kappa^2\omega}\pi_{t+2} + \frac{\kappa}{1+\kappa^2\omega}y^*$ *to substitute out* π_{t+1}*. Then use* $\pi_{t+2} = \frac{\beta}{1+\kappa^2\omega}\pi_{t+3} + \frac{\kappa}{1+\kappa^2\omega}y^*$ *to substitute out* π_{t+2}*. By repeating this process, show informally that*

$$\pi_t = \frac{1}{1-\frac{\beta}{1+\kappa^2\omega}}\frac{\kappa}{1+\kappa^2\omega}y^*$$

where we used that $1+x+x^2+\ldots = 1/(1-x)$ *if* $|x| < 1$*. Rearrange the expression and arrive at*

$$\pi_t = \frac{\kappa}{1-\beta+\kappa^2\omega}y^*. \qquad \text{(Inflation)}$$

4. *Finally, by plugging in* π_t *and* $\mathbb{E}_t\pi_{t+1}$ *in the Phillips curve, show that*

$$y_t = \frac{1-\beta}{1-\beta+\kappa^2\omega}y^*. \qquad \text{(Output)}$$

Optimal policy under discretion: the interpretation Figure 2 shows the optimal path of output and inflation under discretion. Under discretion, the central bank will stimulate the economy in each period and this constant stimulus will result in substantial inflation. Comparing with Figure 1, discretion results in much higher inflation than commitment does, even at time 0. Both output and inflation are constant since the planner faces the same trade-off at each period, and does not take into account the effect of decisions at time t on expectations at time $t-1$ and earlier.

2.3 Optimal inflation rule

Discretion results in constant inflation and constant output. Plugging in a constant output $y_t = \bar{y}$ and a constant inflation $\pi_t = \mathbb{E}_t \pi_{t+1} = \bar{\pi}$ into the Phillips curve, we get the long-run Phillips curve:

$$\bar{\pi} = \frac{\kappa}{1-\beta}\bar{y}.$$

Since $\beta \approx 1$, this is a near-vertical line, capturing the *natural-rate hypothesis*[3] that the long-run Phillips curve is vertical, with the policy implication that sustained stimulus essentially only generates higher inflation. However, the natural-rate hypothesis is not needed for the broader argument and you are more than welcome to consider the case where the long-run Phillips curve is not near vertical (see Blanchard (2018) for a discussion of the issue). We draw this long-run Phillips curve in the (y, π)-plane together with the indifference curves of the welfare function and mark where discretion lands in this plane in Figure 3.

We can also compute the optimal constant inflation and output. The optimal constant inflation is the solution to the maximization problem,

$$\max_{\bar{y},\bar{\pi}} -\frac{(y^* - \bar{y})^2}{2} - \omega\frac{\bar{\pi}^2}{2} \qquad \text{subject to} \qquad \bar{\pi} = \frac{\kappa}{1-\beta}\bar{y}.$$

A simple calculation yields $\bar{y} = \frac{(1-\beta)^2}{(1-\beta)^2+\kappa^2\omega}y^*$ and $\bar{\pi} = \frac{(1-\beta)\kappa}{(1-\beta)^2+\kappa^2\omega}y^*$. This point is also marked in Figure 3.

Two lessons are immediate from Figure 3. First, the outcome under (optimal, benevolent, fully rational) discretionary policy is far from the best constant inflation and output. Whereas discretion leads to persistent high inflation, the optimal long-run policy is to keep inflation much lower. Second, a zero-inflation policy, although not optimal, is much preferred to discretionary policy and in fact quantitatively quite close to the optimal long-run policy.

Again, this is in many ways a surprising result. A well-meaning and competent central bank governor with only the public's best interest in mind is outperformed by a zero-inflation policy. Discretionary policy features what has been called an *inflation bias*: due to time inconsistency, inflation is suboptimally high. This led Rogoff (1985) to propose that, rather than appointing a well-meaning reasonable central bank governor, the central bank should be lead by a dogmatic inflation hawk (*"conservative central banker"*) who is committed to a near-zero inflation policy.

Homework 2 *In this homework, we flesh out the argument of Rogoff (1985). Imagine that the parliament shares preferences with the public, and want to maximize the objective*

$$\sum_{t=0}^{\infty} \beta^t \left(-\frac{(y^* - y_t)^2}{2} - \omega\frac{\pi_t^2}{2} \right).$$

[3] The natural-rate hypothesis was introduced by Friedman (1968). See also the fifty-year symposium on the natural rate hypothesis in the Journal of Economic Perspectives (Mankiw and Reis, 2018, Blanchard, 2018, Hall and Sargent, 2018).

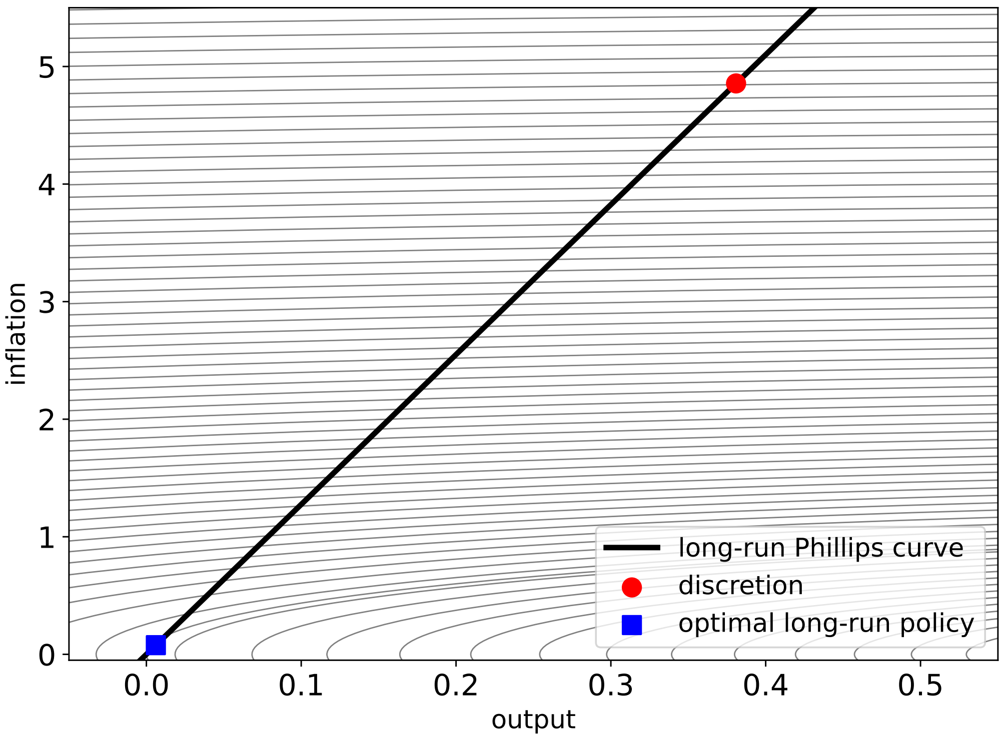

Figure 3: The long-run Phillips curve and the indifference curves of the welfare function. The natural-rate hypothesis, that the long-run Phillips curve is (near) vertical, holds true for this example, notice the different scales of the axes.

The parliament does not decide on policy directly but instead appoints a central banker to conduct discretionary policy. There are several candidates for the job as central bank governor, who differ with respect to their preferences over output and inflation. Concretely, central banker i has preferences

$$\sum_{t=0}^{\infty} \beta^t \left(-\frac{(y^* - y_t)^2}{2} - \omega_i \frac{\pi_t^2}{2} \right)$$

where ω_i is specific to central banker i. There are many central bankers, for each $\tilde{\omega} \in \mathbb{R}_+$, it is possible to find a central banker i with preferences $\omega_i = \tilde{\omega}$.

1. *Argue, using the results from Homework 1, that appointing a central banker i with preferences $\omega_i = \tilde{\omega}$ results in inflation and output given by*

$$\pi_t = \frac{\kappa}{1 - \beta + \kappa^2 \tilde{\omega}} y^*,$$
$$y_t = \frac{1 - \beta}{1 - \beta + \kappa^2 \tilde{\omega}} y^*.$$

2. *As a consequence, all of the candidate central bankers generate constant inflation and output. Using the results on optimal constant inflation and output, show that the parliament should appoint a central banker with preferences* $\omega_i = \frac{\omega}{1-\beta}$.

   Since $\omega_i > \omega$*, we thus conclude that the parliament should appoint a central banker which dislikes inflation more than the public (a "conservative central banker").*

Of course, the inflation bias inherent in discretionary policy is only one factor to consider. There are other benefits from discretionary policy, in particular the ability to respond to new and unexpected events. See Clarida et al. (1999) for a further discussion.

3 Inflation targeting as a response to the time consistency problem

The time consistency problem not only earned Kydland and Prescott the Nobel Prize in Economics, it also provided a key intellectual underpinning for the introduction of inflation-targeting independent central banks. Motivated by arguments summarized by Figure 3, an independent central bank with a clear inflation target seemed like a better institutional setup than a central bank under the ministry of finance, which would be subject to both benevolent short-term discretionary policy and political pressure.

How do we characterize whether a central bank is independent? Of course, a central bank is and should never be *fully* independent.[4] Independence is more about arms-length distance from the executive and legislative branch, which can give the central bank objectives but should not interfere with the central bank's conduct of policy directly.

Cukierman et al. (1992) quantifies the degree of central bank indepence by evaluating whether the central bank is *de jure* independent:

- Is the central bank governor appointed by the central bank's board (rather than the legislative, or the executive branch)? Can he/she be dimsissed for any reasons? Can he/she hold other positions in the government while acting as central bank governor?

- Does the central bank formulate policy with advice or participation from other branches of the government? Does it have final say in the conflicts about its legal objectives?

- Does the central bank have a single objective for price stability? (or several possibly conflicting objectives, or no objective at all)

- Can the central bank lend to the government? If so, under which circumstances? (idea: the central bank should not finance the government deficits)

[4] An anecdote relayed to me by Ragnar Torvik of NTNU: the employees of the Zimbabwean central bank once secretly printed massive amounts of cash, distributed it among themselves, and went out to purchases goods at various markets before the public realized that the money supply had increased and inflation would ensue. An example of an independent central bank answering to absolutely no one ("independence"), but obviously not what we are after.

TABLE 1: MONETARY POLICY REGIMES IN SELECTED ECONOMIES, 1993-2023

	ADVANCED ECONOMIES		
	1993	**2007**	**2023**
DISCRETION	Greece, Japan, Norway, USA	Iceland, Japan, USA	Iceland
EXCHANGE RATE MANAGEMENT	Austria*, Belgium*, France*, Ireland, Israel, Netherlands*, Portugal*, Denmark, Hong Kong, Iceland	Denmark, Hong Kong	Denmark, Hong Kong
MONETARY AND EXCHANGE RATE TARGETS	Italy*, South Korea, Switzerland Germany*, Spain*		
INFLATION TARGET	Finland*, Australia, Canada, New Zealand, Singapore, Sweden, UK	Australia, Canada, New Zealand, Singapore, Sweden, UK, euro area, Israel, Norway, South Korea, Switzerland	Australia, Canada, New Zealand, Singapore, Sweden, UK, euro area, Israel, Japan, Norway, South Korea, Switzerland USA
	EMERGING MARKET ECONOMIES		
	1993	**2007**	**2023**
DISCRETION	Brazil, India, Indonesia, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Bulgaria, China, Croatia*, Hungary, Latvia*, Lithuania*, Romania	Argentina, China, Croatia*, Egypt, India, Malaysia, Pakistan	Argentina, China, Egypt, Malaysia, Pakistan
EXCHANGE RATE MANAGEMENT	Argentina, Cyprus, Egypt, Estonia, Jordan, Morocco Czech Rep, Malta*	Bulgaria, Cyprus*, Estonia*, Jordan, Latvia*, Lithuania*, Malta*, Morocco	Bulgaria, Jordan, Morocco
INFLATION TARGET	Chile	Brazil, Chile, Czech Rep, Hungary, Indonesia, Mexico, Peru, Philippines, Poland, Romania	Brazil, Chile, Czech Rep, Hungary, India, Indonesia, Mexico, Peru, Philippines, Poland, Romania
	***INDICATES THAT THE COUNTRY SUBSEQUENTLY JOINED THE EURO AREA**		

Source: David Cobham, 'A comprehensive classification of monetary policy frameworks in advanced and emerging economies', Oxford Economic Papers, January 2021, 73(1): 2-29. Data downloaded December 6, 2024, from Monetary Policy Frameworks – A comprehensive classification of monetary policy frameworks, by Prof. David Cobham of Heriot-Watt University. We elect 2012 as the date of the adoption of inflation targeting in the United States, and 2013 as the date for Japan. We also identify Isreal as an advanced, rather than emerging market, economy.

Table 1: Inflation targeting adoption across countries over time.

However, this way of studying whether a central bank is independent cannot capture whether it is *de facto* independent. Arms-length distance between the executive branch and the central bank can be practice without being required by law, and, conversely, the central bank can be under informal political pressure even if the law says it should not.

A broader discussion of central bank independence is given in Crowe and Meade (2007).

Table 1, copied from Kiley and Mishkin (2025), shows how both advanced and emerging economies moved from discretionary monetary policy toward inflation targeting from the 1990s to today, partly motivated by the academic literature on the time-inconsistency problem. In the table, the monetary policy regimes of countries are classified as being either discretionary, exchange rate management (i.e., a currency peg), subject to monetary and exchange rate targets (i.e, either a target for the money supply or the exchange rate), or subject to an inflation target. In the left-most column, the classification of the countries in 1993 is given. There is a large variation in monetary regimes. However, by 2023 (the right-most column), a clear majority of countries operate with an inflation target.

3.1 A brief case study: the introduction of inflation targeting in Sweden

For an example of how the time-inconsistency problem was used to justify the introduction of inflation targeting, in Sweden a government-commissioned report on the central bank and price stability was published in 1993 (SOU 1993:20, 1993). In the English summary of the report, the authors write the following, explaining in plain language the time-inconsistency problem:

> Experience and research in recent decades have identified a number of mechanisms which impede the achievement of policy objectives. The success of any economic strategy presupposes, among other things, that the policy is *credible*, that is, the public must expect that the policy will stand firm and be continued. If that is not the case, their economic decisions will obstruct or counteract the attainment of policy objectives. There may be short-term reasons for a government to depart from the long-term strategy; the public's perceptions that such reasons exist alter the policy conditions and may prevent a continuation of the long-term strategy. In the event, for instance, of expectations that the future rate of inflation will be higher than declared by the government, achieving low inflation will be impossible or costly. The occurrence of short-term incentives for a government to deviate from its long-term target for inflation may thus lead to higher inflation even in the shorter run, without reaping any benefits such as lower unemployment. (p. 20)

While SOU 1993:20 (1993) was being written, Sweden entered a deep financial crisis. A broad consensus emerged that several reforms were needed for the Swedish economy, and a commission was appointed to outline such reforms. Lindbeck et al. (1994) proposed 113 reforms to the Swedish economy following the deep recession of the early 1990s. Number two on the list was the introduction of an inflation-targeting central bank:

> Assign a long-term price stabilization goal to the Bank of Sweden. Make the bank more independent, but at the same time more accountable to the parliament.

Under the heading *Central Bank Reform* they motivate the proposal. In addition to the time-consistency problem discussed in this note, they point out that an independent central bank also safeguards against short-term political pressure to stimulate the economy in order to gain public opinion.[5]

> Our proposals on this issue are based both on recent economic theory and international evidence. Theory emphasizes how discretion in monetary policy, together with political pressure on the central bank to stimulate the economy, may generate an excessively expansionary policy–both on the average and at the wrong point in time (Persson and Tabellini 1990 and Cukierman 1992 survey this theory). According to this theory, the political principal of the central bank can strengthen the long-term commitment to an anti-inflationary policy by delegating monetary policy to an institution removed from day-to-day politics. The leadership of that institution needs a well-defined target for their activities, and must be held accountable as to how well they succeed in meeting the objective.
>
> Evidence, particularly from the past two decades, suggests that those countries that have succeeded at containing inflation also have independent central banks that emphasize price stability (see Cukierman 1992 and Grilli et al. 1991). These countries have not done worse than others in terms of output or employment. (The central bank's reform report and its appendixes contain an exhaustive exposition of both theory and evidence.)
>
> Delegation to an independent central bank with a clear formulation of its objectives is, of course, fully compatible with the basic principle of bringing about a clearer division of labor between the government and its various agencies, as discussed in chapter 1 and further in chapter 5, but the notion of a more independent central bank can only be realized if firmly anchored in political and public opinion. (pp. 44-45)

Sweden adopted inflation targeting in 1993, and subsequently also made the central bank more independent. The time-inconsistency problem was of course not the only reason for the adoption of inflation targeting, but it was a key argument in the two government-commissioned reports underlying the reform and as far as I can tell, not much Norwegian academic discussions of the issues.

3.2 The cases of New Zealand and Norway

Although the Swedish introduction of inflation targeting was explicitly motivated by the academic literature, the first country to adopt inflation targeting was New Zealand in 1990 and the motivation for their inflation-targeting regime was more mundane. Goodhart (2010) notes that "one of the most interesting facets of the 1989 Reserve Bank Act is that one of the main motives for it did not come from monetary policy or monetary

[5]Needless to say, this point is not without relevance today. For a textbook treatment of the political dimensions of monetary policy, see chapters 15-17 of Persson and Tabellini (2005).

analysis at all. Instead, intense dissatisfaction had developed with the intervention, meddling, and direct (micro) management with all aspects of the economy by the previous (National) government, led by Sir Robert Muldoon".

In Norway, the central bank adopted inflation targeting in 2001 but the central bank is still to this day less formally independent than many other central banks. Inflation targeting was introduced in Stortingsmelding nr. 29 (2001) in conjunction with Norway's fiscal rule ("handlingsregelen"). As described in Stortingsmelding nr. 29 (2001), the central bank had argued for a few years in favor of inflation targeting prior to the government's decision to formally adopt it. In contrast to the Swedish case, there was no government-commissioned report or other documents on reforming the central bank preceeding the reform.[6]

After a revision of the central bank regulation in 2018, the regulation currently reads as follows:

> § 1. Pengepolitikken skal opprettholde en stabil pengeverdi gjennom lav og stabil inflasjon.
>
> § 2. Norges Bank forestår den operative gjennomføringen av pengepolitikken.
>
> § 3. Det operative målet for pengepolitikken skal være en årsvekst i konsumprisene som over tid er nær 2 pst. Inflasjonsstyringen skal være fremoverskuende og fleksibel, slik at den kan bidra til høy og stabil produksjon og sysselsetting samt til å motvirke oppbygging av finansielle ubalanser.
>
> § 4. Norges Bank skal jevnlig offentliggjøre de avveiingene som ligger til grunn for den operative gjennomføringen av pengepolitikken.
>
> (§ 1. Monetary policy should maintain a stable monetary value through low and stable inflation.
>
> § 2. Norges Bank is responsible for the operational implementation of monetary policy.
>
> § 3. The operational target for monetary policy shall be an annual increase in consumer prices that is, over time, close to 2 percent. Inflation control shall be forward looking and flexible, such that it can contribute to high and stable production and employment, and to prevent the accumulation of financial imbalances.
>
> § 4. Norges Bank shall regularly publish the considerations that form the basis for the operational implementation of monetary policy.)

[6]However, two articles were written in the early 1990s in Sosialøkonomen (today: Samfunnsøkonomen) related to central bank independence and time inconsistency. Both were written versions of "trial lectures" held by young, up and coming, economists as part of their PhD defenses (see Torsvik (1993) and Vikøren (1994)). If you choose your courses carefully at the University of Oslo, you have the opportunity to meet both of them!

3.3 Implementing a low inflation regime: not only central bank independence

The math above consisted of a planner's problem which we interpreted as the central bank's problem. But it is far from clear that the central bank has the capability of simply choosing the inflation rate.

First, the central bank can end up in a situation where it "plays a game of chicken" with the politicians: the central bank wants to keep inflation low but the politicians run perpetual deficits. There are only two ways for the government budget constraint to add up: (i) the politicians change their fiscal stance and run a surplus or (ii) the central bank accepts higher inflation, thereby inflating away the debt. The "game of chicken" refers to the question of who will give in. In the literature, if the central bank "monetizes the debt", printing money to pay off bond holders, then we are in a world of *fiscal dominance*. Conversely, if the politicians give in and run surpluses, then we have *monetary dominance*. A successful inflation-targeting regime requires monetary dominance, i.e., that the government chooses not to run perpetual deficits.[7]

Second, the central bank can also end up playing a game of chicken with the unions. If the wage setting process is such that wage increases are steadily higher than is warranted, relative to productivity increases and inflation, it is hard to imagine that this does not spill over into higher inflation. To combat this inflation, the central bank may need to set such high interest rates that the value of an independent central bank gets called into question by the general public, resulting in the politicians dismantling the independence of the central bank.[8]

It is thus widely understood that a successful low-inflation regime requires complementary institutions for both the government budget process and the wage formation process. For example, Lindbeck et al. (1994)'s reform proposals three and seven read, respectively:

> Stabilize the public-sector debt in relation to GDP. The debt (mainly nominal debt in domestic currency) should be transformed into indexed bonds and bonds in foreign currency. To make this program credible, important institutional changes are called for.
>
> To increase the probability of low inflation, we advise the parties in the labor market to limit wage negotiations to one level (sectoral or firm level), even if other working conditions may be negotiated at a higher level.

[7]See Leeper and Leith (2016) for an introduction to the literature on monetary-fiscal interactions. Note that the US has been running large deficits for a long time, and that recent research concludes that the US case is a puzzle (Jiang et al., 2024). Also note that the Eurozone adds an additional layer of complexity, a game between national governments, central EU, and the ECB. Whether national governments default or the ECB will monetize their debt has been not only a theoretical question but central to the sovereign-debt crisis of the Eurozone. See for example Cochrane et al. (2025) for a book-length discussion.

[8]A possible master thesis could be to study Leeper and Leith (2016) and think through how/whether the wage setting processes in, say, Norway compared to Argentina change any of the conclusions. Is it, in analogy to monetary and fiscal dominance, possible to have *union dominance*?

4 Concluding remarks

The time-inconsistency problem is central to good policy. How do we design institutions such that the public can trust the government to not renege on its promises? Monetary policy is one application of this problem and we also touched on the patent system. However, the time-inconsistency problem pervades many areas of policy. For example, a wealth tax raises revenue today but reduces incentives for the future. Optimal policy, under commitment, is generally to levy a gigantic wealth tax today ("expropriation") and then promise to never do so again. But can a government credibly commit to not expropriating again if it has done so once?

In the analysis of these questions, it is natural to adopt a dynamic approach with at least an element of rational expectations. Thus, the time-inconsistency problem also serves as an introduction to the "modern" macroeconomic research of the last fifty years.

We reviewed some arguments for central bank independence and the spreading of the institution of inflation targeting. Currently (August 28th, 2025), we are seeing what appears to be an attempt from the president to break with central bank independence in the USA, so the topics of this note are more topical than they have been for a long time.[9]

Homework 3 *Imagine that the current minister of finance of Norway is widely regarded as a rational, benevolent social planner, possibly the only such person in the country. In light of the time-inconsistency problem, and possibly other considerations, discuss the pros and cons of having the minister of finance as central bank governor.*

References

Barro, R. J. and Gordon, D. B. (1983). Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*, 12(1):101–121.

Blanchard, O. (2018). Should We Reject the Natural Rate Hypothesis? *Journal of Economic Perspectives*, 32(1):97–120.

Clarida, R., Galí, J., and Gertler, M. (1999). The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature*, 37(4):1661–1707.

Cochrane, J. H., Garicano, L., and Masuch, K. (2025). *Crisis cycle: challenges, evolution, and future of the euro.* Princeton University Press, Princeton.

Crowe, C. and Meade, E. E. (2007). The Evolution of Central Bank Governance around the World. *Journal of Economic Perspectives*, 21(4):69–90.

Cukierman, A., Web, S. B., and Neyapti, B. (1992). Measuring the Independence of Central Banks and Its Effect on Policy Outcomes. *The World Bank Economic Review*, 6(3):353–398.

[9] See, e.g., Yellen (2025).

Friedman, M. (1968). The Role of Monetary Policy. *American Economic Review*, 58(1):1–17.

Galí, J. (2015). *Monetary policy, inflation, and the business cycle: an introduction to the new Keynesian framework and its applications*. Princeton University Press, Princeton Oxford, 2nd edition.

Goodhart, C. A. E. (2010). The Political Economy of Inflation Targets: New Zealand and the UK. In Leeson, R., editor, *Canadian Policy Debates and Case Studies in Honour of David Laidler*, pages 171–214. Palgrave Macmillan UK, London.

Hall, R. E. and Sargent, T. J. (2018). Short-Run and Long-Run Effects of Milton Friedman's Presidential Address. *Journal of Economic Perspectives*, 32(1):121–134.

Jiang, Z., Lustig, H., Van Nieuwerburgh, S., and Xiaolan, M. Z. (2024). The U.S. Public Debt Valuation Puzzle. *Econometrica*, 92(4):1309–1347.

Kiley, M. T. and Mishkin, F. S. (2025). The Evolution of Inflation Targeting from the 1990s to 2020s: Developments and New Challenges. *Finance and Economics Discussion Series*, (2025-025):1–1.

Kydland, F. E. and Prescott, E. C. (1977). Rules Rather than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy*, 85(3):473–492.

Kydland, F. E. and Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations. *Econometrica*, 50(6):1345–1370.

Leeper, E. and Leith, C. (2016). Understanding Inflation as a Joint Monetary–Fiscal Phenomenon. In *Handbook of Macroeconomics*, volume 2, pages 2305–2415. Elsevier.

Lindbeck, A., Molander, P., Persson, T., Petersson, O., Sandmo, A., Swedenborg, B., and Thygesen, N. (1994). *Turning Sweden Around*. MIT Press. OCLC: 1466027196.

Lucas, R. E. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, 1:19–46.

Mankiw, N. G. and Reis, R. (2018). Friedman's Presidential Address in the Evolution of Macroeconomic Thought. *Journal of Economic Perspectives*, 32(1):81–96.

Persson, T. and Tabellini, G. E. (2005). *Political economics: explaining economic policy*. Zeuthen lecture book series. MIT Press, Cambridge, Mass.

Rogoff, K. (1985). The Optimal Degree of Commitment to an Intermediate Monetary Target. *The Quarterly Journal of Economics*, 100(4):1169.

Schelling, T. C. (1960). *The strategy of conflict*. Harvard Univ. Press, Cambridge, Mass.

SOU 1993:20 (1993). *Riksbanken och prisstabiliteten*.

Stortingsmelding nr. 29 (2001). *Retningslinjer for den økonomiske politikken.*

Sydsæter, K., Hammond, P., Seierstad, A., and Strøm, A. (2008). *Further mathematics for economic analysis.* FT Prentice Hall, Harlow München, 2nd edition.

The Royal Swedish Academy of Sciences (2004). Finn Kydland and Edward Prescott's Contribution to Dynamic Macroeconomics: The Time Consistency of Economic Policy and the Driving Forces Behind Business Cycles. *Advanced information on the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel.*

Torsvik, G. (1993). Truverde i valutakurspolitikken. *Sosialøkonomen*, 1993(1):20–25.

Vikøren, B. (1994). Argumenter for og imot en uavhenging sentralbank. *Sosialøkonomen*, 1994(9):2–9.

Yellen, J. (2025). Trump's attack on the Fed threatens US credibility. *Financial Times.*