Time-Inconsistent Policy with Distributional Conflict and Costly Wage Adjustment

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Abstract

This paper develops a dynamic model of inflation in which discretionary monetary–fiscal policy interacts with distributional conflict between workers and firms. Unlike the canonical Barro–Gordon framework, inflation is socially costly not only because of volatility but also because it redistributes income when nominal wages adjust sluggishly. Policy makers face time-inconsistent incentives to generate inflation in order to stimulate employment, but also internalize the costs of wage adjustment, while workers attempt to defend their real wage subject to bargaining costs.

The interaction between policy incentives, wage-setting frictions, and expectation formation renders the optimal inflation rate time-varying and sensitive to institutional features of the labor market. Inflation may be higher or lower than in the absence of distributional conflict, depending on policy priorities over employment versus real wages, the cyclicality of real wages, and the horizon over which wage contracts are reset. When workers possess perfect foresight, stronger real-wage defense dampens inflation and improves welfare by reducing volatility. When prohibitively high information collection costs result in static expectations, however, the same mechanisms reverse the welfare ranking. The framework nests the standard Barro–Gordon outcome as a special case and connects modern policy debates to classical themes concerning wage bargaining, income distribution, policy credibility, and Kalecki's "threat of the sack." By explicitly incorporating distributional considerations into policy optimization, the paper offers a unified approach to understanding inflation persistence and the political economy of macroeconomic stabilization.

JEL classifications: E24, E31, E63, E64, J50.

Keywords: Inflation, distributional conflict, time consistency, monetary and fiscal policy, inflation, wage bargaining.

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1 Introduction

[William] Nordhaus compared inflation to what happens in a football stadium when the action on the field is especially exciting. Everyone stands up to get a better view, but this is collectively self-defeating — your view doesn't improve because the people in front of you are also standing, and you're less comfortable besides. Krugman (2023)

This paper explores the interactions between the incentive for policy makers to generate inflation and the resulting distributional conflict between economic groups. The optimal route for the policy makers in this context is driven by their ideological orientation, as captured by the relative weights that they assign in the trade-off between real wages and employment, by the character of the distributional conflict, and by the informational and adjustment cost asymmetries between economic groups. This exercise, which can be generalized in several dimensions, formalizes an important new element to the debate about the nature and costs of inflation.

It is widely recognized that inflation redistributes income between different economic groups. Typically economic agents with assets or incomes whose value is relatively fixed in nominal terms lose to the benefit of the corresponding holders of liabilities. Labor income in the presence of nominal rigidities is an example. Wage bargaining carries costs for workers, often leading to nominal wage growth that lags inflation. It is also well-understood that the monetary authority or central bank has incentives to generate inflation other than those driven solely by seigniorage motives. Under various specifications of private expectation formation, these incentives lead to social welfare gains from lower unemployment. With perfect foresight, by contrast, equilibrium unemployment becomes independent of policy, and the incentive to generate inflation leads merely to efficiency losses. This outcome reflects the inability of the central bank to systematically generate surprises. As we argue below, however, the presence of wage adjustment costs and distributional conflict make this picture more complicated.

Costs that lead to nominal wage rigidity can come in different forms. One source of such costs is the lack of information about future developments. Information collection, both for gathering macroeconomic data and for understanding the underlying data generation process, i.e., the economic model, can be costly and these "information costs" often cause nominal wages to lag behind changes in the aggregate price level. Even if information gathering costs are negligible, the wage renegotiation process constitutes another source of costs. As discussed in more detail in the next section, wage negotiations involve costly bargaining, which acts as a dampener on worker willingness to ask for raises, especially when inflation is low. These "wage adjustment costs" could erode real wages even when workers have perfect information about the current and future path of inflation. While the two sources – information collection and wage adjustment – may not be mutually independent, the distinction is crucial and will play a focal role in our analysis.

With regards to the causal mechanisms, while more mainstream models of inflation emphasize the role of money, aggregate demand, and government debt, the "conflicting claims" model of inflation homes in on the hypothesis that inflation reflects class struggle over distribution. Workers and capitalists have target distributional shares. Any deviation from these targets sets into motion efforts by the affected party to undo the change. With fixed mark-ups over unit labor costs and sluggishness in nominal wage adjustment, this leads to aggregate price changes. Steady state inflation corresponds to a situation where distributional shares are constant over time and neither party is fully satisfied with their share. With reference to the Nordhaus quote at the beginning of this section, this is akin to a situation where everyone stands up in a stadium to see better without anyone achieving their objective.

The monetary and fiscal authorities presumably have a say in how this distributional dispute evolves. What role does policy have to play in mediating this conflict? More specifically, how does policy reconcile the optimal inflation rate from his/her perspective with the constraint arising from distributional conflict? How would the nature of wage adjustment influence policy? Since they presumably understand the distributional trade-offs that arise from inflation, it is not clear why the policy makers would adopt one set of policies over another. This points to an underexplored theme in the literature: in the presence of conflict, the level of inflation that policy makers desire to generate should partly depend on their preferences over income distribution.

This paper contributes to exploring these questions. To the extent that existing literature studies the time inconsistency of central bank incentives, it does not address how distributional conflict impacts these incentives over time. Insofar as the literature explores the role of conflict in sustaining inflation, it typically does not formally link this to broader central bank incentives. Workers have a distributional target in the form of the real wage. Once policy actions cause a deviation from this target, conflict comes into play. While in the standard Barro-Gordon set-up there is no explicit cost to inflation other than volatility, I incorporate the welfare effects of distributional changes that follow from inflation. This makes the desired level of inflation time-varying. The optimal rate of inflation can be high or low depending on whether: (i) policy makers see the real wage as a good or a bad (i.e., whether the shadow price of real wage inflation is positive or negative), (ii) workers have high or low bargaining power, (iii) the real wage is pro- or countercyclical, and (iv) the tenure of distributional arrangements is short or drawn out. Although, taken together, each of these dimensions can be explored in an essentially unmanageable number of permutations, the aim here is to provide an over-arching architecture to gain insights into the interactions between inflation and conflict.

The next section gives a brief overview of existing literature. Section 3 develops the formal framework, starting with the baseline case where policy makers assign no weight to the real wage and workers act passively in the face of surprise inflation, and then analyzing various deviations from this baseline that involve distributional conflict. Section 4 briefly discusses the implications of modifying some of the crucial assumptions. Section 5 concludes.

2 Background and Literature

With their seminal contributions Barro and Gordon (1983a) and Barro and Gordon (1983b) illustrated how interactions between private expectations and monetary policy motives yield inflation.[1] The central bank has time inconsistent incentives. Under discretion, there is an incentive to generate inflation in order to pump employment and output beyond the "natural" or "structural" level. While policy makers can then generate surprises under a discretionary regime, they cannot do so *systematically* over time. An equilibrium that incorporates peoples' understanding of policy makers' incentives results in higher inflation but without the benefit of greater employment. The efficiency loss due to higher inflation, in other words, is not countered by the social welfare gains from greater employment. Thus, enforceable commitment turns out to be preferable to discretion in that, by getting rid of the temptation to generate surprises, it moves the economy to a superior equilibrium.

A large body of subsequent work has helped illuminate the role of reputation building and repeated interactions.[2] But this literature ignores an important issue. Inflation has consequences for income distribution. This has two implications: (1) policy makers may not be indifferent between equilibria involving different income distributions, and (2) agents in the economy are likely to respond to the changes affecting income distribution by trying to maintain/increase their purchasing power. This, in turn, may affect the equilibrium behavior of inflation.

Some recent empirical literature highlights the importance of inflation in influencing distributional patterns and workers' response to such changes. Guerreiro et al. (2024) is one such relevant study. Based on a survey of 3,000 US workers from the beginning of 2024, they explore the reasons why workers dislike inflation. Employers do not automatically give raises in the face of inflation. Rather, workers have to fight for them using means such as tough negotiations, union activity, or soliciting outside job offers. This, of course, creates costs and lags, which are high enough to dissuade some workers from pursuing wage increases. Their survey responses lead them to conclude that the median worker is willing to sacrifice 1.75 percent of his/her wage to avoid conflict. Put succinctly, inflation imposes significant costs beyond the impact on real wages and conflict plays a crucial role in determining wage growth.

Stantcheva (2024) report related findings based on two representative surveys of the US population. The predominant reason for aversion to inflation, they find, is the widespread perception that it erodes purchasing power, as wages fail to match the pace of rising prices. Respondents in their study, therefore, reported having to make costly adjustments in their behaviors. Many respondents also appeared to believe that firms opt not to raise wages, instead using the available leeway provided by rising prices to boost profits. Moreover, respondents typically did not recognize the potential positive consequences of inflation,

[1] Barro and Gordon were, in turn, building on the formal analysis of the dynamic inconsistency of optimal policies initiated by Kydland and Prescott (1977).

[2] See, for example, Rogoff (1985), Persson and Tabellini (1990) and Drazen (2000).

such as reduced unemployment.[3]

Although, as evidenced by the quote at the beginning of this paper, some macroeconomic literature has taken the role of distributional conflict in sustaining inflation seriously,[4] economists associated with the Post Keynesian school have assigned it a centrality that no one else has. Rowthorn (1977) is the seminal paper in this respect.[5] Broadly speaking, wage- and price-setting behavior is understood as reflecting conflicting claims over income distribution between workers and owners of firms. There is an "aspiration gap" between rival claims. Inflation is the manifestation of these claims playing out over time as the two groups strive to achieve their respective distributional targets at a given level of income. Real wages and firm mark-ups evolve over time as a result. The departure from the precept that "Inflation is always and everywhere a monetary phenomenon" is obvious.

The framework analyzed in the present set-up differs from the typical Post Keynesian conflicting claims one in the sense that it is spending and aggregate demand that are the primary source of inflation. Wage or mark-up changes do not mechanically determine changes in the price level. Rather they influence the trade-offs that the policy maker faces, at a more primitive level, while making fiscal/monetary choices.

Outside of the Post Keynesian tradition, formal modeling of distributional conflict as a factor in inflation has been scarce with a few exceptions. Blanchard (1986) is one. The paper builds on the theme of a wage-price spiral that, according to Blanchard, used to be "a central element" of macroeconomic dynamics for a long time. In his model, wage-price dynamics make a comeback in spite of the presence of rational actors, thanks to staggered price- and wage-setting.

Skott (1997) introduces labor market considerations to analyze an extended version of the Barro-Gordon model that incorporates union-led bargaining. Labor does not consist of atomized price-taking individuals. Instead, a labor union, acting as a Stackelberg leader, incorporates dislike of inflation into its objective function bargains, on workers' behalf. An interesting implication is that, even under perfect foresight, the actions of the policy maker can impact unemployment. Unlike the present paper, the focus is on the interaction between unions and policy makers rather than the consequences of incorporating bargaining costs and distributional outcomes directly into the policy maker's payoff considerations.

Lorenzoni and Werning (2023) provide a more general framework for analyzing the nature of conflicting claims inflation. They study the mechanics of conflict and decompose it into two components. The *conflict* component reflects

[3] Afrouzi et al. (2024), another recent study that is based on nationally representative surveys of the US population, reaches related conclusions. They find that the median consumer desires an inflation rate close to zero. Further, their analysis suggests that the perception of real wage erosion has a causal impact on inflation preferences.

[4] One can see early hints of this in the now rather dated Bronfenbrenner and Holzman (1965).

[5] See Rowthorn (2024) for a recent survey.

the difference in aspirations over real income between the two groups. This is the component that sustains both price and wage inflation. The *adjustment* component, on the other hand, is related to a weighted average of the aspirations as it differs from the actual real wage. This latter component determines the real wage dynamics. There is no role for a policy maker in the analysis as the focus of the analysis is different from ours.

As we see later, the framework we develop to analyze policy in the presence of conflict inflation can be employed to carry out several thought exercises in a flexible manner. We illustrate this, in particular, with a brief exercise related to the history of economic thought. In a famous paper, Kalecki (1943) attributed stringent macroeconomic policies associate with low inflation as driven by the need for the pro-business policies to maintain the "threat of the sack." By maintaining unemployment at less than full employment levels, policy makers may use such policies to discipline wage demands.

Under some institutional arrangements, centralized wage negotiations that occur every few years, set the tone for wage increases over during those years. Societal mandates or expectations, such as maintaining the real wage over a given period of time or ensuring that the real wage does not deviate, on average, from the path of productivity improvement over those years then drives wage evolution in light of expected inflation. We deal with such cases and shed some light on possible implications.

3 Distributional Conflict: The Model and Analytics

Consider an economy with no technological change. Firms set prices as a mark-up over costs. The mark-up factor is a pre-determined variable as is the real wage. We treat the monetary and fiscal authorities as a single entity called the "policy maker(s)." These policy makers take into account public dislike for volatility in inflation, which is denoted by π and have an announced target $\bar{\pi}$. On the other hand, they have an incentive to boost (monetized) spending in order to generate employment. The deviation of actual inflation from its expected value is, as a result, a function of the deviation of (log) output y_t from the (log) level generated by the "natural" or non-inflationary rate of output y_n. The policy maker seeks to use monetary and fiscal surprises to create employment which induces inflation as a by-product. Output is determined by aggregate demand, which, without loss of generality, we limit to government spending. Other considerations, assigned weights η and θ in the objective function, include the real wage (w in log form) and price stability.[6] Throughout, t denotes the

[6] The basic set-up can be motivated in the simplest possible standard terms as follows. Unemployment (u) is a negative function of aggregate demand (or monetized government spending in our case) and an exogenous variable denoted by k. The actual and expected price level (P and P^e), nominal wage (W), mark-up (τ), and inflation (π) are related through the following equations.

$$P_t = (1 + \tau_t)W_t$$

time variable.

The policy makers care about the real wage for two reasons. One pertains to income distribution and the potential for conflict. A second plausible reason is external competitiveness. For these reasons, and since there is no technological change, real wages cannot deviate from their initial value indefinitely. Under the assumption that the welfare function favors a high real wage, $\eta > 0$. We will explore the implications of modifying this assumption in Section 4.

The discussion so far can be encapsulated by the following two equations.

$$V_{t0} = \int_0^\infty \left[\eta w_t + \beta(y_t - y_n) - \frac{\theta}{2} (\pi_t - \bar{\pi})^2 \right] e^{-\rho t} dt$$

$$\pi_t - \pi_t^e = \alpha (y_t - y_n) \tag{1}$$

where α captures the slope of the Phillips curve, ρ is the subjective discount rate, and π_t^e is the level of inflation expected by the workers. We treat these expectations more explicitly later. Substituting the Phillips curve relationship into the policy maker's utility function yields,

$$V_{t0} = \int_0^\infty \left[\eta w_t + \varepsilon\gamma(\pi_t - \pi_t^e) - \frac{\theta}{2} (\pi_t - \bar{\pi})^2 \right] e^{-\rho t} dt \tag{2}$$

where $\varepsilon = \beta/\alpha$ and $\gamma \in [0, 1]$ is an inverse measure of worker bargaining power or bargaining costs as discussed below.

In the absence of technological change, and given competitiveness and distributional considerations, the real wage cannot rise or fall forever. This makes the infinite horizon set-up hard to justify. With distributional conflict resulting in real wage changes over finite time horizons, the real wage will realistically undergo major periodic re-alignments from time to time. In our analysis, we will treat the terminal instant as an exogenously fixed time T, which is set by

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$$W_t = P_t^e(1 - au_t + k)$$

so that,

$$\frac{P_t}{P_t^e} = (1 + \tau_t)(1 - au_t + k)$$

or, approximating in time change form:

$$\pi_t - \pi_t^e = \tau_t - au_t + k$$

Using u^n to denote the non-accelerating level of inflation,

$$\pi_t - \pi_t^e = a (u^n - u_t)$$

Finally, resorting to Okun's Law at a constant level of productivity turns this into a positive relationship between inflation and output, as captured by equation (1).

When policy generates spending (and under imperfect foresight, employment), inflation rises. Workers, in turn, play catch-up and re-negotiate wages with a lag (due to limited bargaining power and adjustment costs), which means a higher mark-up in the meantime and, thus, an anti-cyclical real wage, as captured by equation (4) discussed below. If, by contrast, worker bargaining power is sufficiently high so that wage inflation exceeds price inflation, the mark-up correspondingly declines.

cultural, institutional, and economic considerations beyond the control of the policy maker. The real wage will be re-aligned back, as a result of wage reset negotiations at the society-wide level, to its initial level w_0 at this time.[7] The relevant objective functional for maximization thus takes the following form:

$$U_{t0} = \sum_{n=0}^{\infty} \int_{nT}^{(n+1)T} \left\{ \eta w_t + \varepsilon\gamma(\pi_t - \pi_t^e) - \frac{\theta}{2}\left(\pi_t - \bar{\pi}\right)^2 \right\} e^{-\rho t} dt \tag{3}$$

The policy maker maximizes this functional using monetized spending, and hence inflation, as the control variable. Workers form their expectations about the trajectory of inflation over $[nT, (n+1)T)$ at the beginning of each period: for illustration let's suppose $n = 0$. They set their negotiated wages accordingly at $t = 0$. Surprise inflation can then drive workers to renegotiate their nominal wages during the interval $(0, T)$ in an attempt to maintain purchasing power. As discussed earlier, there is evidence that such bargaining is costly, and the resulting process involves some nominal wage rigidity. The real wage is, therefore, a state variable that evolves in an anticyclical manner for most of the analysis (we will consider procyclical real wages briefly in Section 4). That is, it takes time for workers to significantly restore their real wage in the presence of inflation and this lagged partial adjustment erodes purchasing power during the process. Thus, for most of our analysis, the real wage w_t at time t is the initial real wage w_0 adjusted for a proportion of the cumulative inflation in excess of expectations since that initial moment.

$$w_t = w_0 - \int_0^t \gamma\left(\pi_s - \pi_s^e\right) ds$$

or, alternatively, taking the time derivative,

$$\dot{w}_t = -\gamma\left(\pi_t - \pi_t^e\right) \tag{4}$$

It is important to devote some more space here to the interplay of expectation formation and wage-setting in the rest of the paper. As noted previously, wage bargaining and adjustment are costly processes. These costs come in various forms; we will focus on two: (1) information collection costs at $t = 0$, and (2) wage bargaining costs over $t \in (0, T]$. Collecting information about the future trajectory of inflation generated by the economic process is costly for workers. We make the admittedly extreme simplifying assumption of static expectations to reflect the case where such costs are prohibitive. By contrast, we make the assumption of perfect foresight to reflect negligible information collection costs. Section 3.6 makes the intermediate assumption of regressive expectations.

Wage bargaining costs are different in nature. These involve tactfully negotiating, searching for alternative employment positions, moving between jobs,

[7] Sections 3.4 and 3.5 consider alternative wage arrangements.

coordinating with unions, and other costly activities. Once workers have negotiated a trajectory for their nominal wage over $t \in [0, T]$, adjustment costs make it hard to re-negotiate relatively small changes along the way. In our specification, these aspects are implicitly captured by the parameter γ. The lower the wage bargaining costs or the stronger the workers' bargaining position, the lower the value of this parameter. In the case where γ equals zero, workers are continuously able to maintain their real wage. A negative value of γ, considered as a special case in Section 4, corresponds with a procyclical real wage. In addition, the Appendix explicitly introduces wage adjustment costs so that the real wage falls with inflation even if workers have perfect foresight.

Rowthorn (1977) makes the case for distinguishing between *expecting* something (which is simply to believe that it will happen) and *anticipating* something (which is both to expect something and to act upon this expectation). That distinction is relevant here for understanding the role of γ. While, given the stance of fiscal/monetary policy, workers with perfect foresight may expect inflation, they may not have adequate bargaining power to act on these expectations, let alone forestall their consequences for the real wage.

As already noted, our specification above implies that, in the forward-looking case, workers are able to continuously adjust their real wages. In light of the policy incentive to inflate, and the costs of wage renegotiation, it is perhaps more realistic to specify that forward-looking workers set their wages initially at a level that allows them to counter future erosion. Section 3.4 incorporates this feature.

Finally, note from the equation of motion of the real wage that, when $\gamma \neq 0$, inflation in excess of expectations implies that the real wage declines or rises continuously. It stretches credulity to specify that the real wage diverges for extended periods of time absent technical change. The resulting changes in distribution and competitiveness will be too disruptive to last for ever. This motivates our assumption that there is a resetting of the society-wide wage contract at finite horizons. Section 3.5 goes further and imposes the restriction that the real wage at the terminal point equals its initial level so that there is no large, socially disruptive redistribution at the end of each period.

Section 3.1 starts with some corner cases for illustrative purposes. When workers are unable to bargain due to prohibitively high costs, $\gamma = 1$, and policy assigns no weight to the level of the real wage, $\eta = 0$, the optimal path of inflation is flat. The real wage declines throughout. This case delivers the standard welfare results and we treat it as the "baseline" case.

By contrast, when workers have extremely high bargaining power and there is no cost to wage adjustment, $\gamma \to 0$, adjustment is instantaneous and $w_t = w_0$ for all t. Alternatively, if workers have perfect foresight and there are no information collection costs *or* wage adjustment costs, then $\pi_t = \pi_t^e = \bar{\pi}$, and again $w_t = w_0$. The weight assigned to employment then ceases to mold the path of inflation or welfare. Section 3.2 addresses these cases.

Table 1 provides a summary of some key results to help keep track as we walk through the sections.

3.1 The Baseline Case: Unconcerned Policy Maker Meets Lack of Conflict

To set a benchmark, and to nest the Barro-Gordon case in our general framework, let's start with a scenario where there is no sustained conflict in the sense that, even though workers are blessed with perfect foresight, new wage negotiations during $t \in (0, T)$ are prohibitively costly so that they have no bargaining power when faced with *surprise* inflation, and passively accommodate it. Further, policy makers, who realize this lack of bargaining power, do not care at all about the real wage, assigning it no weight in the utility functional. Time consistency requires that the policy makers take expectations as exogenous (Barro and Gordon (1983a)).

Setting γ equal to 1 and η equal to zero, and solving the maximization problem yields the optimal value of inflation in this context. Based on the problem defined by equations (3) and (4), we derive the standard result that the optimal level of inflation, which is higher than the announced target $\bar{\pi}$, is given by:

$$\pi_t^B = \bar{\pi} + \frac{\varepsilon}{\theta} \tag{5}$$

Recall that the lack of bargaining power only pertains to surprises. Since workers perfectly foresee the incentive to generate employment and inflation in this baseline case, they set the negotiated wage trajectory accordingly, i.e., $\pi_t^e = \pi_t^B = \bar{\pi} + \frac{\varepsilon}{\theta}$. The real wage remains unchanged throughout, as a result, and policy is unable to create employment. Why then generate inflation at all? The reason is simple. The employment benefit of inflation increases linearly with the level of inflation. The cost, by contrast, increases non-linearly. At $\pi = 0$, the cost of an additional unit of inflation is non-existent while the marginal benefit is ε, so that it makes sense to generate inflation. Since the resulting inflation does not dent unemployment, the efficiency loss induced by inflation volatility results in welfare losses. Specifically, from equation (3),

$$U_{t0}^B = -\frac{\varepsilon^2}{2\theta\rho} \tag{6}$$

This of course is the standard result, which follows from: (1) the effective exclusion of the real wage from the objective functional, and (2) the absence of distributional conflict during the interval $(0, T]$.

Alternatively, for comparison purposes, let's continue to assume extremely low worker bargaining power, so that $\gamma = 1$, but now suppose that the workers consistently expect inflation to equal the central bank's announced target, $\bar{\pi}$. This is the extreme case where information collection costs are sufficiently high so as to render workers' *a priori* expectations static. With high information collection costs, the level of inflation is identical to that under perfect foresight. However, the Phillips curve is now non-vertical, and equation (1) helps pin down the excess of output (and employment) above y_n from equation (1) at $\varepsilon/\alpha\theta$. The real wage at any point in time t, which the reader will recall is not part of the policy payoff function in this sub-section, is given by $w_t = w_0 - \frac{\varepsilon}{\theta}t$.

Exploiting the trade-off is welfare-improving in this case.

$$U_{t0}^{S} = \frac{\varepsilon^2}{2\theta\rho} \tag{7}$$

In the absence of perfect foresight, there are gains from announcing a target and then using policy discretion to deviate from it (i.e., cheat). In this case,

$$\Delta U_{t0}^{S-B} = U_{t0}^{S} - U_{t0}^{B} = \frac{\varepsilon^2}{\theta\rho} \tag{8}$$

A few things to notice before we conclude this sub-section. The maximum level of welfare achievable is independent of the length of the time horizon, T. This follows from the feature that, while the real wage continuously declines, this is of no concern to policy. Second, as in the standard Barro-Gordon case, it is the difference between success or otherwise in generating employment that affects welfare. Third, even though inflation has distributional implications, there is no role for distributional conflict in influencing the optimal path of inflation. As in the standard Barro-Gordon set-up, the source of inflation is time inconsistent incentives rather than differences over income distribution. Fourth, equilibrium inflation is constant over time and varies positively with the weight assigned to employment generation.

Let's next consider the case where worker bargaining power is high enough so as to essentially render the real wage exogenous.

Table 1: Key results from Sections 3.1-3.3

Section		3.1	3.2	3.3
Parameters		$\eta = 0,\ \gamma = 1$	$\eta > 0,\ \gamma = 0$	$\eta > 0,\ \gamma \in (0,1)$
Inflation		$\bar{\pi} + \frac{\varepsilon}{\theta}$	$\bar{\pi}$	$\bar{\pi} + \frac{\gamma}{\theta}\left[(\varepsilon - \Lambda) + \Lambda e^{-\rho(T-t)}\right]$
U_{t0}	Perfect foresight	$-\frac{\varepsilon^2}{2\theta\rho}$	0	$-\frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right]$
	Static expectations	$\frac{\varepsilon^2}{2\theta\rho}$	0	$\frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right]$

All results displayed after setting $w_0 = 0$.

3.2 Worker Dominance

This sub-section shows that, with a fully defended real wage, inflation has no employment effect and there is no incentive to deviate from the target since any such deviation strictly lowers welfare via volatility costs.

Let's start again with the case where workers are blessed with perfect foresight but now have adequate bargaining power to prevent any real wage erosion in the face of inflation (i.e., $\gamma = 0$). That is, workers face no information collection or wage adjustment costs and are able to continuously maintain their real wage, which can then be treated as exogenous at $w_t = w_0$. Policy makers realize this and incorporate it in their payoff function.

Setting γ equal to zero, recalling that $\eta > 0$ and based again on the problem defined by equations (3) and (4), one derives the result that the optimal level of inflation equals the announced target $\bar{\pi}$.

$$\pi_t^D = \bar{\pi} \tag{9}$$

Since workers perfectly foresee the incentive to generate employment and inflation in this case, $\pi_t^e = \pi_t^{R1} = \bar{\pi}$. Workers are able to continuously defend their real wage. Realizing this, policy makers find it pointless to spend with the aim of generating employment. Since the resulting inflation equals the target, and does not dent unemployment, there are no welfare losses or gains, except those that follow from maintaining a positive real wage at its initial level. Specifically, from equation (3),

$$U_{t0}^{R1} = \Lambda w_0 \tag{10}$$

where $\Lambda \equiv \eta/\rho$ is the discounted cost of a unit of surprise inflation.[8] Alternatively, for comparison purposes, let's continue to assume extremely high worker bargaining power, so that $\gamma = 0$, but now suppose that the workers expect inflation to equal the central bank's announced target, $\bar{\pi}$ (i.e., high information costs render expectations static). The resulting level of inflation is identical to that under perfect foresight. Utilizing the trade-off could be welfare-improving except for that, unlike the standard Barro-Gordon case, now workers are able to actively prevent any change in the real wage during $(0, T]$.

$$U_{t0}^{S1} = \Lambda w_0 \tag{11}$$

Again, there is no gain in terms of employment or change in volatility.

$$\Delta U_{t0}^{S1-R1} = U_{t0}^{S1} - U_{t0}^{R1} = 0 \tag{12}$$

[8] We can break down Λ to make intuitive sense. In the case studied here where η is positive, the numerator, i.e., η, is the cost of an instant of inflation generated in terms of a lower real wage while the denominator is the discount rate. The cost is discounted since, unlike the benefit, the cost incurred in a period stays until the terminal instant (recall that the real wage is a pre-determined/state variable).

Also, note that the derivation of equation (10) makes use of the property that $\sum_{n=0}^{\infty} e^{-\rho n t} = \frac{1}{1-e^{-\rho T}}$.

A few things to notice before we conclude this sub-section. With the real wage fixed at w_0, the weight assigned to the real wage, i.e., η, does not play a role in equation (12). This is true regardless of the nature of expectation formation. Second, policy is unable to leverage spending to target equilibrium employment in either case. The only loss avoided is that due to inefficient excessive inflation. Third, since inflation has no distributional implications, there is no role for distributional conflict to influence the optimal path of inflation. Fourth, inflation is constant over time. With an exogenous real wage, the policy maker loses any incentive to utilize discretion to generate employment. Cheating by deviating from the announced target serves no purpose.

Next we introduce distributional conflict by effectively endogenizing income distribution and introducing costs to nominal wage adjustment in a meaningful manner.

3.3 Imperfect Bargaining Power and Cheating

Before we deal with expectations and wage adjustment costs, it is important again to distinguish between two types of costs: (1) information gathering costs that could impact the magnitude and speed of worker expectations adjustment in the face of changing policy stances, and (2) wage adjustment costs that workers experience when resisting declines in real wages. These wage adjustment costs, that make it hard to renegotiate once the trajectory of nominal wages has been agreed upon at $t = 0$, could exist even if workers can gather information costlessly and have perfect foresight.

The analysis that follows in this section starts by assuming away information gathering costs so that, while interim wage adjustment involves costs ($\gamma > 0$), workers can foresee the future path of inflation perfectly and negotiate at $t = 0$ accordingly. We then introduce information gathering costs that are prohibitively high so that worker expectations regarding inflation are static. In this case the real wage evolves over time as distributional conflict ensues. Section 3.6 considers the case of regressive expectations which in a sense can be considered an intermediate case.

The maximization of the utility functional as defined by equation (3) is now subject to the constraint represented by equation (4). The policy maker takes workers' inflation expectations as exogenous to its actions, thus creating incentives for time-inconsistent behavior. As we will see below, and unlike the original Barro and Gordon (1983a) case, optimal inflation turns out not to be constant over time. Also, the distributional changes emanating from inflation have consequences in terms of welfare. This is because policy makers realize that workers react to distributional changes but with a lag, thanks to adjustment costs. Crucially, policy design internalizes this cost of adjustment.

Perfect Foresight

As noted earlier, wage adjustment too involves costs and is unlikely to be instantaneous and frictionless even if workers anticipate policy actions and understand their consequences. Moreover, this is known to the policy maker. To accommodate these wage adjustment costs in the simplest possible manner, we employ the specification captured earlier by equation (4), with $0 < \gamma < 1$, and which we repeat here for convenience.[9] Recall that the parameter γ captures the interaction of bargaining power and wage adjustment costs. The Appendix presents a more detailed version where wage adjustment costs are explicitly specified.

$$\dot{w}_t = -\gamma \left(\pi_t - \pi_t^e\right) \tag{13}$$

Using standard optimal control techniques, we find that the optimal path of inflation is now no longer time-invariant in this non-cooperative Nash set-up.

$$\pi_t^* = \pi_t^e = \bar{\pi} + \frac{\gamma}{\theta}\left[(\varepsilon - \Lambda) + \Lambda e^{-\rho(T-t)})\right] \tag{14}$$

Intuitively, the policy maker desires to raise employment but, is also concerned about the real wage, and internalizes the additional cost of wage adjustment for workers. This results in a lower trajectory of inflation.[10] Crucially, note that, if $\Lambda = 0$, that is, there is no welfare cost to generating inflation other than volatility, optimal inflation is identical to the baseline case captured by equation (5) with $\gamma = 1$. Intuitively, the term $\varepsilon - \Lambda$ captures the difference between the immediate marginal benefit and the discounted marginal cost of a unit of inflation. If this difference is non-negative, policy that assigns a positive weight to the real wage will keep inflation low at the beginning and then raise it over time so that it is at its highest as the terminal time T approaches. This makes sense since the discounted cost of inflation at that latter point is zero. Higher inflation, in other words, is left to the end when it matters the least in discounted terms It is also worth noting that the longer the time horizon T, that is, the less frequent wage resettlement to a level consistent with the state of technology in the economy, the lower the optimal inflation level since the damage to workers only increases with time.

The optimal level of inflation is a negative function of worker bargaining power (as reflected in a low value of γ). The intuition is instructive. Workers with a high level of negotiating strength can maintain their real wages over time, making it harder for policy to generate employment.[11] This changes later in Section 4 when we consider scenarios where the policy maker has a different attitude towards the real wage ($\eta < 0$).

It may be worthwhile to explore further the role of η that is, the weight assigned in the welfare function to the real wage. The solution for the time

[9] More realistically perhaps adjustment costs could be specified as decreasing with inflation in a non-linear manner, with wage re-adjustment being more more costly relative to inflation at low levels of inflation. We pursue the simplest possible specification here.

[10] In fact, if the weight on the real wage is high enough, this could lead the policy maker to "undershoot" their stated inflation target in order to minimize the erosion of worker income. To avoid a multiplicity of cases, the maintained assumption throughout this paper is that $\varepsilon \geqslant \Lambda$. This is a sufficient – but not necessary – condition.

[11] An alternative way to understand this is in terms of wage bargaining costs. Since policy internalizes these costs, the higher they are, that is, the higher γ is, the lower the optimal level of inflation.

path of the shadow price of the real wage is given by:

$$\lambda_t = \frac{\eta}{\rho}(1 - e^{-\rho(T-t)}) \tag{15}$$

Thus, the sign of η reflects the orientation of the policy maker. A positive (negative) sign implies that the central bank perceives the real wage as a "good" ("bad"). In the former case, a policy that desires to facilitate a higher real wage will optimally generate low inflation, as long as wage adjustment is costly for workers.

Workers who have perfect foresight understand the policy maker's incentives and negotiate their wages accordingly, so that $\pi_t^R = \pi_t^e$, $w_t^R = w_0$.[12] The following expression for welfare follows:[13]

$$U_{t0}^{R2} = \Lambda w_0 - \frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}}\right] \tag{16}$$

The term in the square parentheses arises entirely from the volatility caused by policy and is, therefore, the efficiency loss from inflation. Since workers are able to foresee the policy-induced future path of inflation, they are able to negotiate the trajectory of nominal wages so as to maintain their real wage. That the policy maker internalizes wage adjustment costs lowers volatility. Notice that, if there is no policy weight assigned to the real wage, i.e., if $\Lambda = \eta = 0$, we are back to equation (6) with $\gamma = 1$. The same is unsurprisingly true if the time horizon is infinitesimally small ($T = 0$). As T approaches infinity, the efficiency loss shrinks to $-\frac{\gamma^2}{2\theta\rho}\varepsilon^2$ which is lower (in absolute value) than U_{t0}^B. Having opted for an inflationary policy, the need to prevent the real wage from falling too much at the beginning presents an incentive to the policy maker to dampen spending and then raise it over time since the discounted loss from volatility is lower, the farther it occurs in the future.

The crucial thing to note given the focus of this paper is that distributional considerations erode the policy maker's incentive to generate inflation. Moreover, discounting makes this consideration weaken over time.

The efficiency loss can be directly compared with the baseline perfect foresight case from the previous sub-section. Recall that there the real wage is essentially exogenous thanks to high worker bargaining power. Formally, based on eqs. (10) and (16):

$$\begin{aligned} \Delta U^{R2-R1} &= U_{t0}^{R2} - U_{t0}^{R1} \\ &= -\frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}}\right] \\ &< 0 \text{ if } \varepsilon \geqslant \Lambda \end{aligned} \tag{17}$$

[12] The Appendix, where wage adjustment costs are more explicitly incorporated, shows that inflation will reduce the real wage in the presence of such costs, even if workers have perfect foresight.

[13] See the Appendix for a more detailed derivation.

The right hand side (hereon RHS) expression collapses to zero if $\gamma = 0$ and is negative as long as $\varepsilon \geqslant \Lambda$ (sufficient not necessary), which is our maintained assumption throughout the main text of this paper. To understand the intuition underlying this latter result, recall that here the difference in welfare is solely driven by inflation volatility.[14] When $\Lambda = 0$, there is no distributional incentive to mitigate inflation, which increases volatility. With $\varepsilon > \Lambda$ ($\geqslant 0$), policy assigns less weight to the real wage relative to employment, which means that the incentive to dampen inflation too is relatively weak, leading to increased accumulated volatility over time. Since $\gamma \neq 0$, unlike the previous sub-section, the policy maker internalizes part of the wage adjustment costs and limits inflation.

Perhaps it will guide understanding if the result derived from equation (17) is illustrated with a figure. The left hand panel of Figure 1, which presents a time plot for the optimal trajectory of inflation (under both perfect foresight and static expectations), helps capture the intuition. The welfare cost of inflation volatility originates from the area between the continuous (blue) curve – which reflects the path of optimal inflation as derived in equation (14) – and the horizontal axis which coincides with the announced target level of inflation, $\bar{\pi}$.[15] Recall that this target level is also the optimal one from equation (9) on which U_{t0}^{R1} is based.

How does accumulated volatility change if the weight assigned to the real wage increases? The downward-shifted dashed curve reflects an increase in the relative weight assigned to the real wage (that is, increased Λ for the same ε). As can be seen in the figure, the area under this curve shrinks as a consequence, which reduces the cumulative difference in welfare between the two cases. This is not surprising since the path of inflation is lower now, as is the accumulated deviation from $\bar{\pi}$.

With $T = 0$, the RHS of equation (17) reduces to $-\frac{\gamma^2\varepsilon^2}{2\theta\rho}$ and with T approaching infinity, it becomes $-\frac{\gamma^2(\varepsilon-\Lambda)^2}{2\theta\rho}$. From the perspective of the policy maker, the employment-real wage trade-off comes alive over time, as seen in the latter case. Finally, if policy assigns equal discounted weights so that $\varepsilon = \Lambda$, the RHS reduces to:

$$\Delta U_{\varepsilon=\Lambda}^{R2-R1} = -\frac{\gamma^2\Lambda^2}{2\theta\rho}e^{-\rho T}$$

which is an increasing function of T. The greater the time horizon, the larger the gains from dampened volatility that arises from the policy maker internalizing wage adjustment costs.

To summarize the key point, with perfect foresight, policy continues to fail in generating equilibrium employment. However, wage adjustment costs (or lack of bargaining power) make it optimal for the policy maker to pursue a lower level of inflation. The consequent decline in volatility limits welfare losses,

[14] Recall that the real wage is w_0 in both cases and the inflation is perfectly anticipated.

[15] The upper, continuous horizontal line in the left panel coincides with the (time-invariant) level of optimal inflation when the real wage is exogenous (see the optimal level of inflation given by equation (5) in Section 3.1).

although less so than in the case where high bargaining power renders the real wage exogenous. This is truer the longer the time between major wage resets. It also stands in stark contrast to the case of static expectations below where an exogenous real wage, as in Section 3.2, would be the *less* preferred arrangement from a policy standpoint.

Static Expectations

Perfect foresight is one end of the spectrum. At the opposite end lie static expectations. Treating expectations as static is, of course, a dramatic simplification. It is unlikely that workers can be systematically and consistently fooled or that information gathering costs are high enough to prevent expectation evolution. It nevertheless serves as a useful thought experiment reflecting a situation that involves high information collection costs.

Inflation continues to be governed by equation (14). Workers believe that the central bank will continuously meet its announced target, i.e., $\pi^e = \bar{\pi}$ and do not update their information as they experience inflation surprises.

One can derive the time path of the real wage which is again time-variant. This is in contrast to the previous sub-section where, with extremely high worker bargaining power (i.e., $\gamma = 0$), the real wage remains unchanged throughout. As in the perfect foresight case, with limited bargaining power, distributional conflict makes the relative policy weights relevant. The greater the concern for employment, the higher the optimal level of inflation that is required to generate employment through spending, and the greater the downward pressure on the real wage over time. The weight placed on the real wage and the fact that policy internalizes the bargaining costs for workers dilute this incentive, serving as a dampener on spending.

$$w_t^{S2} = w_0 - \frac{\gamma^2}{\theta}\left\{(\varepsilon - \Lambda)\,t + \frac{\Lambda}{\rho}\left[e^{-\rho(T-t)} - e^{-\rho T}\right]\right\} \tag{18}$$

Nevertheless, the real wage is lower than in the baseline case of Section 3.1 as long as employment gets sufficient weight so that $\varepsilon \geqslant \Lambda$.[16] By way of contrast, consider the case where ε is sufficiently low relative to Λ. In this scenario, relative policy concern for the real wage is strong enough to entice the central bank to curb inflation below the baseline and the real wage ends up higher than its initial level.

Figure 1 below illustrates the time path of inflation – which is represented by the same blue curve as in the case of perfect foresight – and the real wage. The latter is at its lowest at the farthest instant in time when its value is discounted the most. Unlike the perfect foresight case, where workers were able to maintain their purchasing power, the real wage change depicted in the right panel contributes negatively to welfare.

[16] Again, this is a sufficient but not necessary condition. The precise condition is given by:

$$\varepsilon > \Lambda\left[t - \frac{\Lambda}{\rho}\left(1 - e^{-\rho T}\right)\right]$$

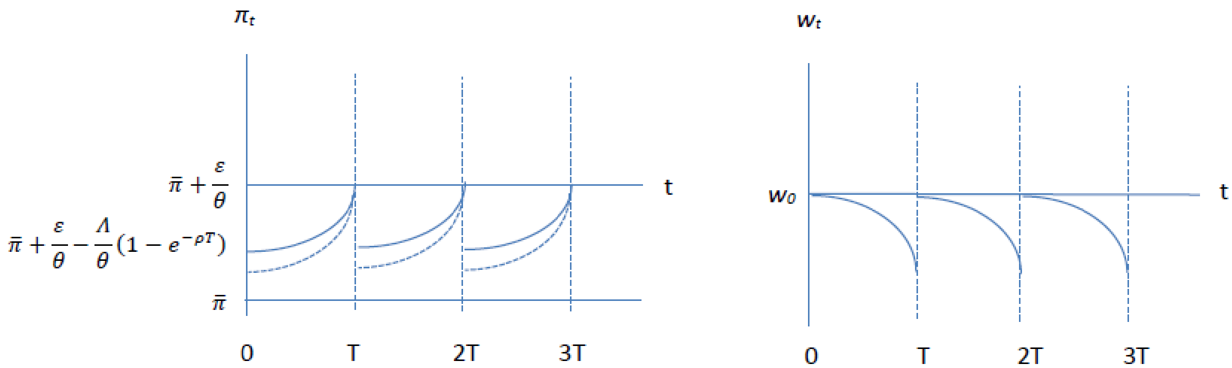

Figure 1: The optimal trajectories of inflation and – when expectations are static – the real wage.

The welfare effects can be calculated as follows (see the Appendix for a more detailed treatment).

$$U_{t0}^{S2} = \Lambda w_0 + \frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}}\right] \tag{19}$$

which, not surprisingly, reduces to the expression in equation (11) once γ is set to zero. The policy maker has internalized the cost of wage adjustment.

Setting $w_0 = 0$ without loss of generality, one notices that the RHS of equation (19) above is the identical mirror image (i.e., negative) of the expression derived based on rational expectations in equation (16). This follows from the success in raising equilibrium employment in this case.

Overall, the expression is more involved than in the static expectations case with an exogenous real wage. The incentive to cheat under a discretionary regime is obvious. Notice first that, if workers have high bargaining power and/or bargaining costs are non-existent, the incentive vanishes. Inability to change the real wage through inflation means no equilibrium employment generation and, therefore, no incentive for policy to inflate. Second, as long as the policy maker places equal or greater weight on employment in relative terms, i.e., $\varepsilon \geqslant \Lambda$, deviation from the announced target produces welfare gains that are increasing in ε. Third, if $\varepsilon = \Lambda$, that is, the real wage and employment get equal weight in discounted terms, the incentive to generate surprises declines as volatility eats into the gains from doing so.

To summarize, even though policy can systematically "fool" workers to generate employment, a policy maker who cares heavily about wages and/or internalizes wage adjustment costs will exert greater effort to limit inflation.

How does welfare compare to the earlier cases? Let's first compare with the case of static expectations and an exogenous real wage from the previous sub-section. Based on eqs. (11) and (19),

$$\begin{aligned} \Delta U_{t0}^{S2-S1} &= U_{t0}^{S2} - U_{t0}^{S1} \\ &= \frac{\gamma^2}{2\theta\rho}\left[(\varepsilon-\Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon-\Lambda)\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right] \end{aligned} \quad (20)$$

which is positive as long as the (sufficient but not necessary) condition $\varepsilon \geqslant \Lambda$ is satisfied, and ranges from $\frac{\gamma^2}{2\theta\rho}\varepsilon^2$ for $T=0$ to $\frac{\gamma^2}{2\theta\rho}(\varepsilon-\Lambda)^2$ for $T\to\infty$. The logic is as follows. With the real wage impacted negatively by inflation, the policy maker chooses to generate employment by keeping inflation higher than the announced target $\bar{\pi}$. This means that, compared to the case with an exogenous real wage path, we end up with higher employment but a lower real wage. If relatively low weight is assigned to the real wage, the policy maker sees positive payoffs. Contra the perfect foresight case analyzed earlier in this sub-section, the ability of workers to maintain the real wage in the face of inflation is costly in terms of employment.

To get a more direct feel for the intuition notice that, if $\gamma=0$, there is no loss of welfare relative to the baseline case. Increased worker bargaining power or lower wage adjustment costs weaken the incentive for policy to deviate from the announced target. The fact that policy has to deal with distributional conflict matters!

As shown in the Appendix, ΔU_{t0}^{S2-S1} decreases in T. The more frequently large real wage resets happen, the better it is for policy to be able to effectively trade off between its employment and wage objectives rather than deal with an exogenous real wage. In the limit, if $T=0$, policy experiences the immediate gain of employment, without the decline over time in the real wage due to conflict. This makes sense. The more time between each reset, the greater the loss in worker purchasing power on account of surprise inflation.

Alternatively, one could compare with the baseline case where there is perfect foresight on the part of workers. Based on eqs. (6), (7), (19), and (20), and setting $w_0=0$,

$$\begin{aligned} \Delta U_{t0}^{S2-B} &= U_{t0}^{S2} - U_{t0}^{B} \\ &= U_{t0}^{S} + \Delta U_{t0}^{S2-S1} \end{aligned} \quad (21)$$

The ability to successfully cheat generates greater welfare than in the case of the comparison between the static expectation cases, as represented by equation (20). The result is intuitive: to the policy inability to influence real wages is now added the efficiency losses that occur in the baseline case.[17]

More generally, and as shown in equation (21) above, it is useful to break down the difference between the case in this subsection and the baseline one in Section 3.1 into two components. The first one is the pure employment generation effect that arises from the fact that, unlike the baseline case, the

[17] That is, to the area between the convex curve and the lower horizontal line is added the area between the curve and the upper horizontal line.

Phillips curve is not vertical thanks to information collection costs. The second component reflects the difference that the real wage is endogenous *conditional* on limited worker bargaining power (i.e., $\gamma > 0$). This second component would disappear if the real wage were exogenous ($\gamma = 0$) and, alternatively, would deliver the standard Barro-Gordon result if the real wage adjusted passively and policy were completely indifferent to it ($\eta = 0$, $\gamma = 1$). Also, recall from the discussion of equation (20) that the sign of this second component is positive as long as $\varepsilon \geqslant \Lambda$. If policy makers assign a high relative weight to the employment, then they are better off with a real wage that can be manipulated since generating inflation surprises in the absence of perfect foresight or wage bargaining costs generates employment.

Finally, on this note, one could compare the two cases in this sub-section where real wages evolve, one under static expectations and the other under perfect foresight (eqs. (16) and (19)).

$$\begin{aligned} \Delta U_{t0}^{S2-R2} &= U_{t0}^{S2} - U_{t0}^{R2} \\ &= \frac{\gamma^2}{\theta\rho}\left\{(\varepsilon-\Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon-\Lambda)\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right\} \end{aligned} \tag{22}$$

The RHS is positive – as long as $\varepsilon \geqslant \Lambda$ – and becomes less so with higher values of T. The real wage is lower while employment is higher under static expectations. Overall, policy makers are better off in the latter case if they assign a higher priority to employment. Rational expectations render the Phillips curve vertical unlike the case of static expectations where the cost of updating inflation expectations is prohibitive. Not surprisingly, employment generation for a given weight assigned to the real wage is less costly in the latter case. Moreover, the incentive to do so by deviating from the inflation target depends negatively on the length of the time horizon T since the real wage declines over time with inflation.

In sum, Sections 3.1 - 3.3 have established that introducing distributional conflict in response to inflation has several interesting consequences, including: (1) a dampening of the trajectory of optimal inflation and gains from decreased inflation volatility compared to the case where real wages passively adjust and policy makers are indifferent to distributional concerns, (2) the elimination of any incentive to generate inflation once policy makers internalize the ability of workers to continuously maintain their real wage, (3) in general, a consistent reduction in the real wage over time, the degree of which depends on policy priorities between employment and real wages, (4) a declining incentive to deviate from the inflation target in the presence of costly information collection as the time horizon before large real wage resets expands, and (5) with perfect worker foresight, a superior welfare outcome when workers can consistently maintain their real wage and the opposite in the case of static expectations, as long as policy makers assign a relatively high weight to employment.

So far we have worked with a set-up where the policy maker has an incentive, in general, to spend and generate inflation while workers play catch up and the real wage is below its initial level throughout the cycle until a big reset occurs that restores the real wage to a level consistent with the state of technology in the economy. But it is unlikely that workers can negotiate a trajectory of wages over the future in response to anticipated inflation. Moreover, such big resets could be socially disruptive. What if workers, instead of repeatedly negotiating ex-ante for a wage path over the interval $(0, T]$, are able to bargain for an initial real wage that maintains their purchasing power, *on average,* over time? Alternatively, what if the central bank implicitly follows a rule that smoothly brings the real wage back to its original level by the terminal point in time? The next two sections explore these themes.

3.4 Maintaining Average Distributional shares

Up until now we have assumed that small wage changes can be continuously re-negotiated in response to surprise inflation, albeit with full or partial catch-up. In a world with wage re-negotiation costs and imperfect information, a more realistic scenario may involve workers negotiating their wage levels at the beginning of the period with an eye on future inflation so as to proactively preempt erosion of their purchasing power without having to renegotiate during the interval $(0, T]$. We now turn to this different version of conflict and show that wage front-loading shifts the timing of distributional conflict but leaves volatility costs unchanged, raising welfare only through a higher constant wage term.

Workers recognize that, given the state of technology in the economy, the real wage cannot deviate much from a given level for sustained periods of time. Recognizing that the policy maker has an incentive to pursue the inflationary path π_t^*, and realizing that continuous re-adjustment is costly, workers bargain for an initial distribution such that, starting with a real wage w_0', they are able to maintain their real wage *on average* over the time period $t \in [nT, (n+1)T]$. This is done at a given level of employment using other institutional mechanisms such as collective bargaining and wage-related legislation (captured by k in footnote 6).[18]

$$w_0' = \frac{1}{T}\int_0^T \int_0^t \pi_s^* ds dt \tag{23}$$

Since the real wage now declines passively with inflation, which is something that workers accommodate at the beginning of the period, γ now naturally equals one, and, from equation (4),

$$w_t = \frac{1}{T}\int_0^T \int_0^t \pi_s^* ds dt - \int_0^t \pi_s^* ds$$

[18] Note that, since the objective functional is independent of w_0', so is the optimal choice of inflation. Moreover, since the initial real wage is set through leveraging the institution mechanisms captured by k, the initial level of employment is not affected.

During the period $(0, T]$, workers do not re-adjust their nominal wage in response to *expected* inflation. Put differently, the term $\varepsilon\gamma(\pi_t - \pi_t^e)$ in the objective functional given by equation (3) now changes to $\varepsilon\gamma(\pi_t^*)$.

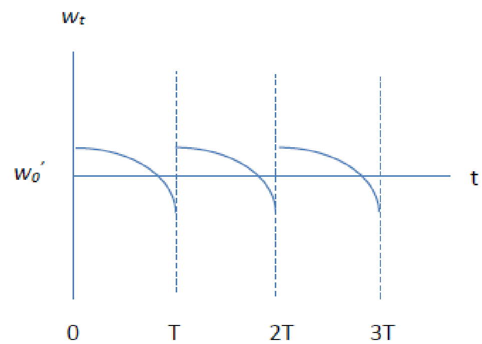

Figure 2: Maintaining average distributional shares

As before, the policy authority sets the level of spending taking worker expectations as given. Figure 2 illustrates the path of the real wage over each period $[nT, (n+1)T]$. Notice that, given our specification, the *net* area between the curve and the horizontal axis for each period is zero.

Fiscal spending generates employment since, having set w_0', workers do not renegotiate until T and inflation results in passive wage erosion. Since optimal inflation deviates from the announced target as in the previous section, the welfare impact from this source is also exactly the same. The more interesting welfare effect is that from real wage evolution. Formally, it can be shown that:

$$U_{t0}^{AVE} = \Lambda w_0' + \frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}}\right]$$

which is exactly the same expression that we get in the case of static expectations with $\gamma = 1$ (section 3.3), with the only difference that $w_0' > w_0$. Once other mechanisms have been used to raise the real wage, a policy maker who prefers a higher real wage benefits from employment generation given the same path of optimal inflation.

To summarize, bargaining for an initial distribution such that the real wage is maintained on average at w_0 over a period replicates the case of static expectations with that initial wage except for that the timing of the conflict has been moved to the beginning in the former case. Explicit incorporation of wage adjustment costs and the costs associate with leveraging k would allow a deeper comparison of the two scenarios in terms of welfare costs.

3.5 Avoiding Socially Disruptive Jumps

Economic agents recognize that, sans productivity growth, the real wage cannot deviate from w_0 for extended periods of time and that huge jumps in distributional variables are likely to be socially disruptive. Recognizing the incentive on the part of the policy maker to inflate, they nevertheless believe that policy makers will avoid large and persistent distributional changes and will strive to maintain the real wage within bounds over extended periods of time. This can be operationalized by supposing that workers do not have sufficient information to form expectations about the instant-to-instant optimal level of spending and inflation over $(0, T]$. Instead, they believe that inflation over the interval $[nT, (n+1)T]$ will be defined by the average of the level of inflation that is optimal from the perspective of the policy maker, and negotiate accordingly. Formally, consider the following specification for expectation formation:

$$\pi_t^e = \frac{1}{T}\int_0^T \pi_t^* dt = \bar{\pi} + \frac{\gamma}{\theta}\left[(\varepsilon - \Lambda) + \Lambda\left(\frac{1 - e^{-\rho T}}{\rho T}\right)\right] \tag{24}$$

where π_t^* is given by equation (14). Workers expect an average level of inflation that varies positively with the policy maker's relative focus on employment and negatively with the terminal time horizon.[19]

Again, using (3) and (4), we can trace the time paths of our variables, as shown in Figure 3. The real wage initially rises with spending but recovers to its initial value as inflation catches up with and then exceeds worker expectations. Since workers overestimate inflation over the interval $(0, T/2)$, spending initially leads to employment losses, even as the real wage is unchanged between the initial instant and the terminal one.

$$\dot{w}_t = -\gamma\left[\pi_t^* - \frac{1}{T}\int_0^T \pi_t^* dt\right] \tag{25}$$

$$w_t = w_0 + \frac{\gamma^2\Lambda}{\theta}\left[\frac{1 - e^{-\rho T}}{\rho T}t - \frac{e^{-\rho(T-t)} - e^{-\rho T}}{\rho}\right] \geqslant w_0$$

Following the previous sub-sections, we can derive an expression for welfare:

$$U_{to}^{TER} = \Lambda w_0 - \frac{\gamma^2}{2\theta\rho}\left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda)\frac{1 - e^{-\rho T}}{\rho T}\right] \tag{26}$$

which is unambiguously negative once we set $w_0 = 0$ and continue to assume that $\varepsilon \geqslant \Lambda$. To understand why, notice that, since inflation undershoots its expected value over the first half of the period, so does employment. Employment then recovers in the second half.

More interesting insights on the tension between distribution and employment can be gained by digging a bit deeper. To see this clearly, let's ignore the portion of welfare losses that is due to volatility and re-derive the expression above after setting w_0 to zero without loss of generality.

$$U_{to}^{TER1} = -\frac{\gamma^2\Lambda(\varepsilon - \Lambda)}{\theta\rho}\left(\frac{1 - e^{-\rho T}}{\rho T} - \frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}}\right) \tag{27}$$

[19] In the limit, where the time horizon approaches infinity, expected inflation is identical to the baseline case with exogenous real wages (and $\gamma = 1$).

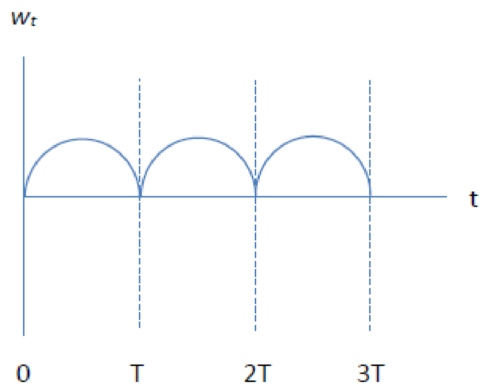

Figure 3: Avoiding social disruption

where the term inside the rightmost parentheses is positive. If policy assigns equal discounted weights to employment and the real wage, i.e., $\varepsilon = \Lambda$, its implementation leaves welfare unchanged (sans losses due to volatility). Why? Consider the paths of inflation and the real wage. The former is still represented by Figure 1 while the latter is captured by Figure 3. Also, recall that workers expect inflation to be approximated by the average of the value given by the optimal time path, so that the element of surprise inflation has a discounted mean of zero:[20]

$$\pi_t - \pi_t^e = \frac{\gamma\Lambda}{\theta}\left(e^{-\rho(T-t)} - \frac{1-e^{-\rho T}}{\rho T}\right) \tag{28}$$

We now have the ingredients to understand the intuition underlying equation (27). Initially, inflation falls below its expected value, which corresponds to lower than period-average employment but an increasing real wage. These have opposite welfare effects. Once inflation has risen above its expected value, recovering employment coexists with a declining real wage, again with opposite welfare effects (although the contributions of the two sources have switched signs). If equal weights are assigned to the two policy objectives, these neutralize each other and the only overall loss over the entire time period is that due to volatility.

Another interesting comparison that highlights this aspect is that with the case where workers have perfect foresight and form expectations accordingly (see equation (16)).

$$\begin{aligned}\Delta U_{t0}^{TER-R2} &= U_{t0}^{TER} - U_{t0}^{R2} \\ &= -\frac{\gamma^2\Lambda}{\theta\rho}(\varepsilon-\Lambda)\left[\left(\frac{1-e^{-\rho T}}{\rho T}\right) - \frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right]\end{aligned}$$

[20] Notice that of the two terms inside the parentheses on the RHS of equation (28), one is the average of the other over $t \in [0, T]$.

The term inside the square parentheses is non-negative. Since workers do not take into account instant-to-instant changes in the present section, they initially overestimate and then underestimate inflation. Put differently, spending initially raises the real wage but lowers employment, and then lowers the real wage and raises employment. As long as employment gets more weight, the overall discounted effect is negative. To solidify intuition, note that the term inside the square parentheses equals $\varepsilon - \Lambda$ once ρ approaches 0, unlike the perfect foresight case in Section 3.3 where eliminating volatility *entirely* eliminates welfare losses.

This sub-section starkly underlines an important lesson. From equation (27) we learn that, if policy makers are equally concerned about distribution and employment, workers accurately form expectations about the average of future inflation, and the real wage is bound by technological parameters so that the initial and terminal real wage and employment are identical, an incentive to modulate spending still exists owing to the *timing* of discounted losses and gains.

3.6 Regressive Expectations

To the set-up introduced through equations (3) and (4), let's now add an equation for expectation formation.

$$\dot{\pi}_t^e = -\phi\left(\pi_t - \bar{\pi}\right) \tag{29}$$

Workers expect the central bank to adhere to the inflation target over extended periods of time. However, expectation adjustment involves information updating costs – albeit less prohibitive than in the static expectations case – in addition to the wage adjustment costs captured by equation (4). If current inflation is above the announced target, they expect contractionary policy in the next period.

The shadow price of the real wage evolves as in Section 3.3 (see equation (15)). The shadow price of the new state variable, i.e., expected inflation, evolves as follows:

$$\mu_t = -\gamma\left[\frac{(\varepsilon - \Lambda)}{\rho}(1 - e^{-\rho(T-t)}) + \Lambda(T-t)e^{-\rho(T-t)}\right] \tag{30}$$

While the welfare analysis becomes complicated, a few interesting observations can be gleaned from the solution for inflation.

$$\begin{aligned}
\pi_t^{RE} &= \bar{\pi} + \frac{\gamma}{\theta}\left\{\left[(\varepsilon - \Lambda) + \Lambda e^{-\rho(T-t)}\right]\right. \\
&\quad \left. + \phi\left[(\varepsilon - \Lambda)\frac{1 - e^{-\rho(T-t)}}{\rho} + (T-t)\,\Lambda e^{-\rho(T-t)}\right]\right\} \\
&= \pi_t^* + \phi\left[(\varepsilon - \Lambda)\frac{1 - e^{-\rho(T-t)}}{\rho} + (T-t)\,\Lambda e^{-\rho(T-t)}\right] \qquad (31)
\end{aligned}$$

which at $t = T$ is the same as the baseline case represented by equation (5). As before, policy concern about the real wage lowers the optimal trajectory of inflation. Expectations evolve in response to deviations from the target.

$$\pi_t^{e-RE} = \bar{\pi} - \frac{\gamma\phi}{\theta}\left\{t + \phi(\varepsilon - \Lambda)\frac{\rho t - e^{-\rho(T-t)} + e^{-\rho T}}{\rho^2} + \Lambda\frac{e^{-\rho(T-t)} - e^{-\rho T}}{\rho} + \frac{\phi\Lambda}{\rho}\left[\left(T + \frac{1}{\rho} - t\right)e^{-\rho(T-t)} - \left(T + \frac{1}{\rho}\right)e^{-\rho T}\right]\right\} \quad (32)$$

with $\pi_t^{e-RE} = \bar{\pi}$ at $t = 0$.

Note again, first of all, that if $\gamma = 0$, that is, in the standard case where policy does not internalize wage bargaining costs, how expectations are specified does not matter for the optimal level of inflation given by equation (31). Incorporating such considerations changes this, underlining the interplay between expectation formation and distributional conflict. Second, continuing with the assumption that $\varepsilon \geqslant \Lambda$, the optimal path of inflation is higher than in any of the cases studied so far. It is easy to verify that, setting ϕ to zero, takes us back to π_t^* (equation (14)). Why? The policy maker (who takes π^e as given) realizes that information collection costs are lower for workers than in the static expectations case and takes the resulting evolution of expectations into account. Since workers expect reversion to the target, there is an incentive for policy to inflate even more. Put differently, the Phillips curve is steeper than in the static expectations case. Third, as long as policy makers place greater emphasis on employment, inflation is higher than the announced target so that it is consistently expected to decline over the coming time period until the terminal instant. This implies that expansionary policy successfully generates employment and inflation exceeds expectations throughout.[21]

4 Cyclicity and Ideology

How does policy maker ideology and wage cyclicity factor into our analysis? There is a long tradition of debate among macroeconomists about the nature of real wage evolution over the business cycle. We have so far assumed countercyclical real wage behavior (that is, $\gamma \geqslant 0$). While it is arguably consistent with a significant body of existing literature, the debate is far from settled, and procyclicity cannot always be ruled out. Furthermore, we have assumed that policy makers see a high real wage as a "good," that is, $\eta \geqslant 0$. This could change with the ideology of the governing parties and with factors such as exposure to international trade competition.[22] Our framework can rather easily incorporate these important considerations.

We will limit the analysis in this section to the case where the real wage is anticyclical but is now seen as a bad (so $\gamma \geqslant 0$, $\eta \leqslant 0$). As noted earlier, this

[21] See the Appendix for formal expressions.

[22] Bhuller et al. (2022) and Calmfors (2025) discuss the involvement of Nordic governments in wage negotiations and the role of international competitiveness in this context. See Razmi (2015) for a discussion oriented towards low income economies.

could be due to ideological reasons (the policy maker is "pro-business") or due to considerations of international competitiveness. The analysis can, of course, be extended to include cases where the real wage is pro-cyclical.

In the baseline case of Section 3.1 with a passive real wage which is given no weight in the payoff functional, we saw that optimal level of inflation and the welfare analysis are entirely orthogonal to the nature of real wage cyclicity or policy maker ideology. This is hardly surprising but it highlights once again the role of distributional conflict in our analysis. Our changed assumption about the sign of γ plays no role here. The same applies to the analysis in Section 3.2 – once we set to $w_0 = 0$ – where worker bargaining power is high enough to ensure an essentially exogenous real wage.

Turning next to the more interesting case of Section 3.3, it is easy to see from equation (14) that, unlike previously, the trajectory of optimal inflation will now be even higher relative to the announced target. Intuitively, as policy now assigns a negative weight to the real wage, the policy maker will be less reluctant to generate spending and inflation in the face of anticyclical real wage patterns. If information collection costs are low, and workers are able to perfectly incorporate this into their expectations, the efficiency loss is correspondingly higher.

With static expectations, the real wage is lower. This is not surprising given that a lower real wage is now the preferred outcome for policy. Greater employment and a lower real wage translate into higher payoffs, in spite of volatility-related losses, for a policy that is biased towards employment over real wages.[23]

On a final note, we can employ our framework to revisit the Kaleckian "threat of the sack." Kalecki (1943) famously saw unemployment as an instrument used by capitalist-sympathetic policy makers to maintain wage restraint in capitalist economies. The implied assumption is that of pro-cyclical real wages ($\gamma < 0$). Furthermore, in our framework, relatively low emphasis on employment along with a preference for a low real wage can be construed as $\varepsilon \approx 0$ combined with a negative weight on the real wage ($\eta < 0$). Policy makers who want relatively high unemployment to coexist with a low real wage – the latter presumably is the motive behind desiring higher unemployment – will want to combine low spending with a procyclical real wage to achieve their desired end. Returning to Section 3.3, this translates into lower inflation for a given Λ, and with static expectations, lower employment and a lower real wage.

Maximization of welfare involves reduced spending as a device to "discipline" worker real wage demands. This is the threat of the sack in action!

5 Concluding Remarks

Ultimately, inflation is not just monetary but also reflects conflict over real incomes and distributional shares. Recent empirical evidence suggests that inflation is generally costly for workers and disliked by them. Major reasons

[23] See the relevant eqs. (18) and (19).

appear to be that changing prices introduce distributional changes, force workers to invest in information gathering, and motivate pursuit of costly wage catch-up strategies. Taken together these elements – ignored in the standard Barro-Gordon set-up – are likely to have significant implications for the choices made by an optimizing policy maker facing time inconsistent incentives.

After developing a dynamic framework that nests the Barro-Gordon case, we show that incorporating costly wage adjustment and distributional considerations into the policy maker's payoff functional render the optimal choice of inflation time-varying. In the presence of anti-cyclical real wages, policy faces a dilemma between employment and the real wage. Adjustment costs cause inflation to erode worker real income. Internalizing these costs, therefore, dampens the incentive to spend and generate inflation. Although we do not pursue this case in any detail in this paper, if distributional considerations get a sufficiently high weight in the welfare functional, this may even lead policy makers to undershoot their stated inflation target.

With perfect foresight, welfare is enhanced if policy assigns a non-zero weight to the real wage. No employment is generated regardless of the value of this weight. However, a positive weight on the real wage correlates with a favorable policy view of higher real wages, which, by lowering the trajectory of inflation, helps limit efficiency losses. Following the same reasoning, the case where workers have sufficiently high bargaining power to continuously maintain their real wage is superior to the one where wages are eroded by inflation. Intuitively, the policy maker internalizes the extent of worker bargaining power in the former case, and is induced to generate zero inflation as a result.

The latter result is reversed in the case where high information collection costs render expectations static. Welfare now is enhanced if currently employed workers are unable to perfectly defend their real wages. This is because lower real wages are correlated with higher employment. If employment gets priority, this helps boost overall welfare.

Overall, as in the standard case, the ability to generate inflation in the presence of static expectations means that there is an incentive for the policy maker to announce a target and then deviate from it. But the strength of this incentive is diluted, and possibly even reversed, by the need to take distributional considerations into account.

The analysis developed here provides a framework for exploring the interplay between distributional conflict and the employment-wage trade-off. The framework developed here is flexible enough to incorporate varying assumptions about policy views of income distribution, the nature of expectation formation and wage bargaining structures, the cyclicity of wages, and the use of disinflation as a disciplinary device. As usual, however, this initial effort to investigate the role of distributional conflict is limited in scope and can be extended in several interesting directions. We do not take into account reputation evolution and the role of signaling over multiple periods. There is little reason to expect that workers will respond to small or large inflation surprises in a similar manner. One could, therefore, introduce non-linear distributional responses and variable speeds of adjustment to inflation. A large body of literature that investigates the characteristics of political business cycles specifies a negative discount rate in order to focus on policy maker behavior around the time of future elections. Such an extension, easily made in our set-up, could yield interesting insights into the nature of policy making in democracies. We hope to revisit these issues in the future.

6 Appendix

Section 3.3 with perfect foresight and wage adjustment costs

The value of the objective functional in equation (3) along the optimal path can be derived as follows after substituting from eqs. (13) and (14).

$$\begin{aligned} U^{R2} &= \sum_{n=0}^{\infty} \int_{nT}^{(n+1)T} \left[\eta w_t + \varepsilon(\pi_t - \pi_t^e) - \frac{\theta}{2}\left(\pi_t - \bar{\pi}\right)^2 \right] e^{-\rho t} dt \\ &= \sum_{n=0}^{\infty} \int_{nT}^{(n+1)T} \left\{ \eta w_0 - \frac{\gamma^2}{2\theta} \left[(\varepsilon - \Lambda) + \Lambda e^{-\rho(T-t)} \right]^2 \right\} e^{-\rho t} dt \\ &= \Lambda w_0 - \frac{\gamma^2}{2\theta\rho} \left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda) \frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}} \right] \end{aligned}$$

where use has been made of the property that $\sum_{n=0}^{\infty} e^{-\rho n t} = \frac{1}{1-e^{-\rho T}}$.

Recall that the difference between the perfect foresight case with (negligible) wage adjustment costs and that with an exogenous real wage is given by equation (17). The following properties follow:

$$\lim_{T \to 0} \Delta U_{t0}^{R2-R1} = -\frac{\gamma^2}{2\theta\rho}\varepsilon^2, \quad \lim_{T \to \infty} \Delta U^{R2-R1} = -\frac{\gamma^2}{2\theta\rho}(\varepsilon - \Lambda)^2$$

and,

$$\frac{d}{dT}\left(\Delta U_{t0}^{R2-R1}\right) = -\frac{\gamma^2 \Lambda}{2\theta} \left[-\Lambda + 2(\varepsilon - \Lambda) \frac{1 - e^{-\rho T} - \rho T}{\left(1 - e^{-\rho T}\right)^2} \right] e^{-\rho T}$$

The expression inside the square parentheses is negative.

Section 3.3 with static expectations

The value of the objective functional in equation (3) along the optimal path can be derived as follows after substituting from eqs. (14) and (18).

$$\begin{aligned} U^{S2} &= \sum_{n=0}^{\infty} \int_{nT}^{(n+1)T} \left\{ \eta w_t + \varepsilon(\pi_t - \pi_t^e) - \frac{\theta}{2}\left(\pi_t - \bar{\pi}\right)^2 \right\} e^{-\rho t} dt \\ &= \Lambda w_0 + \frac{\gamma^2}{2\theta\rho} \left[(\varepsilon - \Lambda)^2 + \Lambda^2 e^{-\rho T} + 2\Lambda(\varepsilon - \Lambda) \frac{\rho T e^{-\rho T}}{1 - e^{-\rho T}} \right] \end{aligned}$$

Based on equation (20), it can be shown that:

$$\lim_{T\to 0} \Delta U_{t0}^{S2-S1} = \frac{\gamma^2}{2\theta\rho}\varepsilon^2, \quad \lim_{T\to\infty} \Delta U_{t0}^{S2-S1} = \frac{\gamma^2}{2\theta\rho}\left(\varepsilon - \Lambda\right)^2 \tag{A2}$$

and,

$$\frac{d}{dT}\left(\Delta U_{t0}^{S2-S1}\right) = \frac{\gamma^2 \Lambda}{2\theta}\left[-\Lambda + 2\left(\varepsilon - \Lambda\right)\frac{1 - e^{-\rho T} - \rho T}{\left(1 - e^{-\rho T}\right)^2}\right] e^{-\rho T}$$

The expression inside the square parentheses is negative.. Setting $\gamma = 1$ and $w_0 = 0$, one could also compare with the baseline case as given by equation (6).

$$\lim_{T\to 0} \Delta U_{t0}^{S2-B} = \frac{\varepsilon^2}{\theta\rho}, \quad \lim_{T\to\infty} \Delta U^{S2-B} = \frac{\varepsilon^2 + \left(\varepsilon - \Lambda\right)^2}{\theta\rho}$$

Section 3.3 with perfect foresight but now wage adjustment costs explicitly incorporated

We have used the parameter γ in the main text to capture wage adjustment costs. To accommodate these costs more explicitly and in the simplest possible manner, suppose that adjustment costs (c) increase linearly with the level of inflation in excess of the announced target.[24] These adjustment costs do not affect firm profits or employment and thus do not enter the objective functional.

$$\dot{w}_t = -\gamma\left(\pi_t - \pi_t^e\right) - c\left(\pi_t - \bar{\pi}\right)$$

The original objective functional continues to be represented by equation (3). Not surprisingly, the optimal path of inflation is now lower than in the static expectations case.

$$\pi_t^{**} = \pi_t^e = \bar{\pi} + \frac{1}{\theta}\left\{\gamma\varepsilon - \Lambda\left(\gamma + c\right)\left(1 - e^{-\rho(T-t)}\right)\right\}$$

Intuitively, the policy maker desires to raise employment but also internalizes the additional cost of wage adjustment for workers. Given rational expectations, so that $\pi_t^{R3} = \pi_t^e$, the following solutions for real wage follows:

$$w_t^{R3} = w_0 - \frac{c}{\theta}\left\{\left[\gamma\varepsilon - \left(\gamma + c\right)\Lambda\right] t + \frac{\left(\gamma + c\right)\Lambda}{\rho}\left[e^{-\rho(T-t)} - e^{-\rho T}\right]\right\}$$

which is less than w_0 as long as $\varepsilon \geqslant \left(1 + \frac{c}{\gamma}\right)\Lambda$, which is a sufficient but not necessary condition. Additional adjustment costs lower the real wage so that,

[24] The implicit assumption is that any inflation that is consistent with the announced target results in painless nominal wage increases. This assumption is made for symmetry and specifying the cost term as $c\pi_t$ instead makes no qualitative difference to the results.

More realistically perhaps adjustment costs could be specified as decreasing with inflation in a non-linear manner, with wage re-adjustment being more costly relative to inflation at low levels of inflation. We pursue the simplest possible specification here.

unlike the main text, it ends up below w_0 even in the presence of perfect foresight on the part of workers.

Further, setting $w_0 = 0$ without loss of generality,

$$U_{t0}^{R3} = -\frac{1}{\theta\rho}\left\{\frac{\left[(\varepsilon-\Lambda)\gamma\right]^2-(\Lambda c)^2}{2}+\frac{\Lambda^2\left(\gamma^2-c^2\right)}{2}e^{-\rho T}+\Lambda\left[(\varepsilon-\Lambda)\gamma^2+\Lambda c^2\right]\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right\}$$

which, in the presence of negligible wage adjustment costs (i.e., $c \approx 0$), reduces to:

$$U_{t0}^{R3} = -\frac{\gamma^2}{2\theta\rho}\left[(\varepsilon-\Lambda)^2+\Lambda^2 e^{-\rho T}+2\Lambda(\varepsilon-\Lambda)\frac{\rho T e^{-\rho T}}{1-e^{-\rho T}}\right]$$

which is identical to the result for rational expectations in equation (16) of the main text. Workers with perfect foresight preemptively adjust, so that the employment gains vanish. Wage adjustment costs mean, however, that the real wage declines with inflation even under perfect foresight so that the trajectory of the real wage still ends up lower.

If workers are passive ($\gamma = 1$) and the large real wage reset occurs instantaneously, i.e., $T \to 0$, distributional conflict does not come into play and we are back to the baseline, i.e., the RHS of the equation above reduces to that of equation (6). If, at the other extreme, the time horizon for large wage resets is infinite, then distribution and wage adjustment costs come into play:

$$\lim_{T\to\infty} U_{t0}^{R3} = -\frac{1}{2\theta\rho}\left\{\left[(\varepsilon-\Lambda)\gamma\right]^2-(\Lambda c)^2\right\}$$

Section 3.6: The gap between actual and expected inflation with regressive expectations

From eqs. (31) and (32),

$$\begin{aligned}\pi_t^{RE}-\pi_t^{e-RE} &= \frac{\gamma}{\theta}\left\{\left[(\varepsilon-\Lambda)+\Lambda e^{-\rho(T-t)}\right]\right\}\\ &+\frac{\gamma\phi}{\theta}\left\{\left[(\varepsilon-\Lambda)\frac{1-e^{-\rho(T-t)}}{\rho}+(T-t)\Lambda e^{-\rho(T-t)}\right]+t+\phi(\varepsilon-\Lambda)\frac{\rho t-e^{-\rho(T-t)}+e^{-\rho T}}{\rho}\right.\\ &\left.+\Lambda\frac{e^{-\rho(T-t)}-e^{-\rho T}}{\rho}+\frac{\Lambda\phi}{\rho}\left[(\varepsilon-\Lambda)\left(T+\frac{1}{\rho}-t\right)e^{-\rho(T-t)}-\left(T+\frac{1}{\rho}\right)e^{-\rho T}\right]\right\}\end{aligned}$$

which, if $\phi = 0$, reduces to $\pi_t^{RE} = \pi_t^{R2}$. The difference between actual and expected inflation at $t = 0$ becomes:

$$\begin{aligned}\pi_t^{RE}-\pi_t^{e-RE} &= \frac{\gamma}{\theta}\left\{\left[(\varepsilon-\Lambda)+\Lambda e^{-\rho T}\right]\right\}\\ &+\frac{\gamma\phi}{\theta}\left[(\varepsilon-\Lambda)\frac{1-e^{-\rho T}}{\rho}+T\Lambda e^{-\rho T}\right]\end{aligned}$$

while at $t = T$,

$$\pi_t^{RE} - \pi_t^{e-RE} = \frac{\gamma}{\theta}\varepsilon + \frac{\gamma\phi}{\theta}\left[T + \phi\left(\varepsilon - \Lambda\right)\frac{\rho T - 1 + e^{-\rho T}}{\rho} + \Lambda\frac{1 - e^{-\rho T}}{\rho} - \frac{\Lambda\phi}{\rho}\frac{\rho T e^{-\rho T} - 1 + e^{-\rho T}}{\rho}\right]$$

Both the RHS expressions above are positive as long as $\varepsilon \geqslant \Lambda$ (sufficient, not necessary).

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