Unemployment insurance design with repeated choices

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Abstract

This paper characterises the relation between the equilibrium unemployment insurance replacement rate and the frequency of its political choice. We first use a tractable analytical model to show how insurance, incentive, and redistribution effects interact at the equilibrium. We then examine a fully repeated choices equilibrium in a quantitative heterogeneous agents model and show that unemployment persistence, whether a policy is announced first or not, and the type of the political process are key determinants of the relation between the equilibrium replacement rate and the frequency of its choice. In a utilitarian welfare context, we find that the equilibrium replacement rate is higher if the policy is chosen more frequently but this relation is reversed in a median voter context.

Keywords: Unemployment insurance, commitment, job search.

JEL classification: J65, J64, E61, D78

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1 Introduction

The history of unemployment insurance (UI) legislation shows that UI system characteristics are frequently amended. Nationwide elections are the appropriate time for such debates, but these policies can be altered at shorter frequencies due to midterm elections, cabinet changes, and budget cycles, among others. In this paper, we explore how the frequency of the UI policy choice and the absence of commitment attached to this choice affect the nature of the policy itself.

We start by empirically establishing a downward relation between the frequency of the UI policy choice and a measure of the UI benefit level in US across-states data: states that change the policy more frequently are also those providing higher benefits. Formally, insurance and (dis)incentive effects appear from changes in the UI policy. How long a given policy is expected to be enforced should influence both effects. Without a commitment technology, the policy might be revised unexpectedly, and forward-looking agents will include these potential changes in their expectations. As the benevolent social planner integrates agents’ expectations, its policy choice will be impacted. Importantly, the incentive effect depends on the frequency of UI policy changes. In line with these observations, the main contribution of this paper is theoretical: we explain the fundamental channels through which the frequency of the political choice has an impact on the equilibrium UI replacement rate. We use a tractable analytical model to explain the basic intuitions. We then build a fully time-consistent quantitative heterogeneous agents model to disentangle the various channels.

Our analytical model rests on simplifying assumptions such as precluding savings and considering a stylised labour market process without unemployment persistence. We define a tractable equilibrium with non-repeated choices but with a concept of persistence, defined as the probability of prolonging a currently implemented policy in the future. We recover a specific version of the Baily-Chetty (Baily (1978) and Chetty (2006)) optimality condition on the replacement rate, letting us detail the interactions between insurance and incentives appearing at the equilibrium. In this model, the expected duration of a given UI policy has an equal impact on both insurance and disincentive effects. However, an unexpected UI change gives rise to redistribution, the magnitude of which is independent of the policy duration. The government balancing all effects, the equilibrium replacement rate is lower when persistence is

\footnote{For a panorama see Wynnyk (2014).}
higher. This result crucially rests on the possibility to implement immediately a new policy. This occurs, among other things, when the government bypasses the normal legislative process to swiftly implement policies, for instance, in times of economic turmoil.

Our quantitative model builds upon these interactions and adds repeated UI policy choices in a fully time-consistent setting. Its basic building block is a search model with incomplete markets and heterogeneous agents: agents face an unemployment risk and engage in precautionary savings to smooth consumption. The government levies taxes to fund the UI program and chooses the replacement rate. We assume the absence of a commitment technology: the government is unable to bind the economy to the currently implemented UI policy forever and plays a game against its future self.\(^2\) Using the Current Population Survey and the Survey of Consumer Finances, we provide a sensible parameterisation focusing on low-qualified workers, a prime target of most UI programs. Here, whether a new policy comes as a surprise or is announced and implemented only later, we obtain that the equilibrium replacement rate is lower when the policy duration is longer. This is due to unemployment persistence. A new channel involving only insurance and incentives appears: as the frequency of the policy choice decreases, the marginal costs to a rise in the replacement rate increase by a greater magnitude than the marginal gains, pushing down the equilibrium replacement rate. Finally, letting agents save creates yet another channel: they will accumulate precautionary savings and self-insure, reducing the incentive for the government to provide insurance through a high replacement rate.

**Related literature** UI programs have been thoroughly analysed, especially in the context of the principal-agent framework. Shavell and Weiss (1979) or Hopenhayn and Nicolini (1997) are seminal contributions. Related to the time-consistency property, Wright (1986) points out the redistributive role of UI and the impact of the public choice periodicity on the equilibrium replacement rate but in an economy without disincentive effects. Hassler and Mora (1999) study how the nature of labour market flows shapes the equilibrium replacement rate chosen by a median voter when UI policy choices are operated at a given periodicity. Closer to our quantitative model, the role of UI policy in an incomplete markets setting has been first investigated in Hansen and İmrohoroğlu (1992). A substantial number of papers, among which Costain (1997), Acemoglu and Shimer (2000), Pallage and Zimmermann (2001), Wang \(^2\)Formally, we describe a (subgame) Markov-perfect equilibrium.
and Williamson (2002), Joseph and Weitzenblum (2003) or Young (2004), have followed. More recently, Landais et al. (2018a,b) have reframed the question of optimal UI in a business cycles context allowing for both time-varying UI benefits and labor market tightness. Their optimal UI condition also relates to Baily-Chetty but with an additional tightness correction term. We, however, explore this condition in a politico-economic context and none of the papers above consider the commitment issues we tackle. The equilibrium concept of our time-consistent model is mostly derived from Krusell et al. (1997). This concept has been used and refined in Krusell (2002), Krusell (2002), Klein and Rios-Rull (2003), Klein et al. (2005), or Klein et al. (2008). The latter papers are either methodological or are not explicitly about the UI policy.

Our paper is organised as follows. In section 2, we empirically evaluate the relation between the UI policy choice frequency and the level of UI provision. Section 3 introduces our analytical framework and results. Section 4 presents the reference quantitative time-consistent model and its outcomes. Section 5 concludes.

2 Empirical evidence

In this section, we provide empirical evidence on the relation between the frequency of the unemployment insurance (UI) policy choice and the characteristics of the resulting policy using US across-states data. Thereby, we also make it empirically more explicit that the commitment issues a government faces have an impact on the nature of the policy itself.

2.1 Measures

Our main contribution is to relate a measure of the level of the UI policy across US states to the frequency of actual policy changes. In the literature, the UI replacement rate is a staple policy variable as it facilitates policy comparisons and can be easily related to theoretical elements. It would be a natural candidate for our measure as it is our main policy variable throughout the rest of the paper. Unfortunately, such replacement rates do not exist in US data, in the sense that they are not policy variables that UI state laws are setting. The national/state level UI replacement rates are ex post constructs. According to Agrawal and Matsa (2013): "A state’s wage benefit formula typically calculates the highest earnings realized by the worker in four of the last five quarters and seeks to replace approximately 50% of those wages through weekly payments,
subject to minimum and maximum bounds. Much of the variation in insurance benefits, across states and over time, stems from changes to the maximum bounds.” The ex post value of the national/state level replacement rate is the ratio of the above weekly benefit amount and a normalised 40-hour working week income that may not be equal to a claimant’s actual average weekly wage. The key policy variable appearing in across-states data is the maximum weekly benefit amount (max WBA), especially since a large fraction of UI recipients are constrained by this upper bound (see Hsu et al. (2018)). Following a number of contributions empirically evaluating the UI policy, notably Hsu et al. (2018), we also consider max WBA as the main policy variable a given state uses to control the level of UI generosity.

2.2 The data

Our data is collected from the Significant Provisions of State Unemployment Insurance Laws of the U.S. Department of Labor. Our sample contains cross-sectional UI policy characteristics for all US states plus the District of Columbia, Puerto Rico, and the US Virgin Islands, amounting to 53 states. Local government induced changes are reported twice a year, in January and July. The data we observe (i) the month and year of the policy status report; (ii) the US FIPS code identifying the state; and (iii) the max WBA, between January 1990 and July 2017.

The dataset contains 967 across-states changes in the max WBA level over the period and the number of months between any two such changes can be computed. Some states routinely adjust the max WBA to take the evolution of inflation into account. Those operations introduce minute adjustments that are, in essence, unrelated to our experiment. Therefore, we also compute a subsample of 249 observations retaining only changes in the max WBA larger than 5%. All of our results remain valid in both samples.

2.3 Results

From our data, we compute the average number of months between WBA changes for a given state. We use this average as a proxy for the periodicity of the political intervention. We relate the latter to the average CPI-adjusted max WBA in US dollars.

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3See, for instance, this tool of the US Department of Labor at https://oui.doleta.gov/unemploy/ui Replacement Rates.asp for details.

4The data can be found at https://oui.doleta.gov/unemploy/statelaws.asp.
in each state. In Figure 1, we report the above relation taking our variables in logs for all 249 across-states above 5% max WBA changes. Each dot represents the relation for a given state. The dashed line is the slope of the associated linear model.

**Figure 1.** Average number of months between policy changes against the CPI-adjusted average maximum WBA.

![Graph showing the relationship between log average number of months between changes and log average weekly benefit amount (CPI adjusted).](image)

Note: The CPI deflator is base 100 in 2010.

Source: computed using the U.S. Department of Labor’s Significant Provisions of State Unemployment Insurance Laws.

The figure shows a downward relation between the average max WBA and the average number of months between WBA changes. Overall, states that change the max WBA on average more frequently also display a higher average max WBA. Accordingly, our evidence shows that the higher the frequency of the policy adjustment and the higher the generosity of the UI provision. State laws do not implement a specific amount of time before which the UI policy cannot be changed. Therefore, no explicit commitment device transpires in the data as evidenced by the variety of durations between any two UI changes, both across and within states. Thus, our experiment shows that the frequency of UI changes is a relevant dimension to consider in relation to the availability of a commitment mechanism. In the following sections, we provide theoretical and quantitative insights that can explain our empirical observations.
3 Analytical model

In this section, we develop an analytical model under a set of simplifying assumptions: the labour market process is stylised, savings are precluded and, importantly, public choices are not repeated and, thus, are not time-consistent. However, the model will be tractable enough to derive a number of useful interactions regarding the choice of the replacement rate, unemployment, and search effort in the time-consistent model.

3.1 Model specification

The economy is populated by a continuum of households of measure one. Each period, households are either employed or unemployed. UI is compulsory and a government sets the replacement rate.

**Unemployment insurance.** UI is financed by contributions levied on the gross wage $w$. The budget of the public insurance system is assumed to be balanced at every date and respects:

$$w \tau_t (1 - U_t) = \rho_t w U_t$$

with $U$ the unemployment rate and $\rho$ the replacement rate. We derive the tax rate $\tau_t = \tau(\rho_t, U_t) = \frac{\rho_t U_t}{1 - U_t}$ accordingly and define partial derivatives $\tau'_1(\rho_t, U_t) = \frac{\partial \tau(\rho_t, U_t)}{\partial \rho_t} = \frac{\rho_t}{1 - U_t}$ and $\tau'_2(\rho_t, U_t) = \frac{\partial \tau(\rho_t, U_t)}{\partial U_t} = \frac{\rho_t}{(1 - U_t)^2}$.

The government sets the replacement rate as follows: $\rho_t$ is chosen at the beginning of the initial date, $t = 0$, so as to maximise the utilitarian criterion at that date. This replacement rate applies with certainty at the current date, and with probability $\lambda$ in the next period, and so on. $\lambda$ is the persistence parameter: it is the probability of prolonging a currently implemented policy. The initial choice has, thus, a limited life span and with probability $1 - \lambda$, the replacement rate is reset at any point in time to the exogenous long-run constant value $\bar{\rho}$. Consequently, public choices are not repeated in this setting and are not time-consistent. We will nevertheless illustrate a key mechanism present in a time-consistent setup: there is a temptation for the government to deviate by offering higher unemployment benefits and this inclination depends on the frequency of the political choice.

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5We use the following simplifying assumption: the replacement rate applies to all unemployed at $t = 0$, even those who were already unemployed.
Households. Preferences are given by the following time-separable additive expected utility:

$$E_0 \left( \sum_{t=0}^{\infty} \beta^t [u(c_t) - g(\pi_{t+1})] \right)$$

with $c_t$, the date $t$ consumption and $\pi_{t+1}$ the probability of being hired at the beginning of the next period. We assume that $u'(c) > 0, u''(c) < 0$, and $\pi$ is the search effort in this context. Jobs last for a single period and at any given date, all agents, whether employed or unemployed, choose their probability of being hired in the next period. It follows that the unemployment rate in the next period is $U_{t+1} = 1 - \pi_{t+1}$, as all agents search with the same efficiency. The disutility $g(\pi_{t+1})$ is such that $g'(0) = 0, g'(\pi) > 0, g''(\pi) > 0, g'''(\pi) > 0$ and $\lim_{\pi \to \bar{\pi}} g(\pi) = +\infty$, with $\bar{\pi}$ a constant parameter strictly below one.\(^6\) When employed, households earn the exogenous wage $w$ and pay the tax $\tau w$. Unemployed households receive benefits $b = \rho w$, independently of the duration of their current unemployment spell. By assumption, savings are precluded and agents consume their entire income each period.

The current state of the agent consists of her idiosyncratic employment status and the current state of the economy. To simplify notations, we drop time subscripts when possible: at any date, either the replacement rate is still the one chosen at the initial date, denoted $\rho'$, or has reverted to the constant value $\bar{\rho}$. Given this structure, the time 0 formulation of employed ($e$) and unemployed ($u$) agents’ programs are:

$$V_e (\rho', U_0) = \max_{\pi_1} \left\{ u(w(1 - \tau(\rho', U_0))) - g(\pi_1) + \beta \left[ \pi_1(\lambda V_e(\rho', U_1)) + (1 - \lambda)V_e(\bar{\rho}, U_1) \right] \right\}$$

$$V_u (\rho', U_0) = \max_{\pi_1} \left\{ u(\rho'w) - g(\pi_1) + \beta \left[ \pi_1(\lambda V_e(\rho', U_1)) + (1 - \lambda)V_e(\bar{\rho}, U_1) \right] \right\}$$

As $U_1 = 1 - \pi_1$, the search effort $\pi_1$, obtained by maximising the above value functions, depends on both $\bar{\rho}$ and $\rho'$, but it is independent of the current unemployment rate $U_0$. Since $\bar{\rho}$ is exogenous and constant, the search effort and, in turn, next period’s unemployment rate, are a function of the chosen level of the replacement

\(^6\)With this assumption, irrespective of the current search effort, the probability of being unemployed tomorrow is bounded below by a strictly positive value.
rate: $U_1 = \hat{u}(\rho')$. Thus, the chosen exit rate (or, equivalently, the chosen search effort) satisfies the following first-order condition at date $t = 0$:\footnote{The second order condition is verified given the assumptions on $g$. Notice that because employment status is reset each period, a current choice of $\pi$ only impacts next period utility.}

\begin{equation}
\begin{aligned}
g'(\pi_1) &= \beta \left[ \lambda (u(\omega(1 - \tau(\rho', \hat{u}(\rho')))) - u(\rho'\omega)) \\
&+ (1 - \lambda) (u(\omega(1 - \tau(\bar{\rho}, \hat{u}(\rho')))) - u(\bar{\rho}\omega)) \right]
\end{aligned}
\end{equation}

**Public choice.** When the government sets the replacement rate, the current state of the economy is a crucial determinant. It is entirely described by the current unemployment rate $U_0$. Thus, the program of the government is:

$$
\max_{\rho'} W_0 = (1 - U_0)V_e(\rho', U_0) + U_0 V_u(\rho', U_0)
$$

with first-order condition:

\begin{equation}
(1 - U_0) \frac{dV_e(\rho', U_0)}{d\rho'} + U_0 \frac{dV_u(\rho', U_0)}{d\rho'} = 0
\end{equation}

**Equilibrium.** Given initial conditions, consisting of the initial unemployment rate $U_0$, and given $\bar{\rho}$, the government chooses $\rho'$ as the solution to equation (2).

We define the politico-economic equilibrium as the vector $(U_0, \rho')$ such that:

1. The initial unemployment rate $U_0$ is the only one compatible with $\rho' = \bar{\rho}$, and the optimality condition (??),

2. Given $U_0$, and for a future constant replacement rate $\bar{\rho}$, the government finds it optimal not to deviate from its previously chosen replacement rate, that is, $\rho'$ solves equation (2) with $\bar{\rho} = \rho'$.

The equilibrium is stable with respect to the political process: if $\bar{\rho}$ has been applied in the past without any deviation from it, and if the government can deviate at date $t = 0$, it will choose not to.

Compared to a fully sketched time-consistent political choice, this economy (i) does not explain how the economy has reached its initial state and (ii) has no repeated public choice. However, it will still be suited for (i) recovering the Baily-Chetty (Baily (1978) and Chetty (2006)) optimality condition on the replacement rate.
and (ii) underlining the impact of the periodicity of the public choice (given by \( \lambda \)) on the short-run temptation to deviate toward higher replacement rates and, in turn, on the equilibrium replacement rate. Thus, we can analytically characterise the impact of the expected duration of the change in the replacement rate on the equilibrium replacement rate.

3.2 Characterization of the equilibrium

3.2.1 Recovering the Baily-Chetty optimal condition

We can now state the following proposition:

**Proposition 3.1.** At the equilibrium, the necessary first-order condition for the maximisation of the utilitarian criterion is:

\[
\frac{u'(\rho' w) - u'(w(1 - \tau(\rho', U_0)))}{u'(w(1 - \tau(\rho', U_0)))} = \frac{\beta \rho' \hat{u}'(\rho')}{U_0(1 - U_0)}
\]  

(3)

**Proof.** See Online Appendix A.2.1. \( \square \)

This condition is the Baily-Chetty optimality condition, adapted to this framework. The left-hand side (LHS) is the relative gap in terms of marginal utility, between an unemployed agent and an employed one. The lower it is, the better the public insurance against the unemployment risk. The right-hand side (RHS) indicates how costly, in terms of disincentive, the insurance is.\(^8\) At the optimum, insurance gains and disincentive costs are equal.

3.2.2 Existence, uniqueness, and properties of equilibrium

The optimality condition above is based on the function \( \hat{u}(\rho') \), which itself derives from household behaviour. We further characterise this function. We differentiate household optimal condition (??), valid for a given \( \rho \), with respect to \( \rho' \):

\[
g''(\pi_1) \frac{d\pi_1}{d\rho'} = \beta \left[ \lambda \left( \frac{\partial V_c}{\partial \rho'}(\rho', \hat{u}(\rho')) - \frac{\partial V_u}{\partial \rho'}(\rho', \hat{u}(\rho')) \right) \\
+ (1 - \lambda) \left( \frac{\partial V_c}{\partial \rho'}(\bar{\rho}, \hat{u}(\rho')) - \frac{\partial V_u}{\partial \rho'}(\bar{\rho}, \hat{u}(\rho')) \right) \right]
\]  

(4)

\(^8\)Note that the RHS can be rewritten as \( \frac{\beta \varepsilon_{U/\rho'}}{1 - U_0} \) with \( \varepsilon_{U/\rho'} = \frac{\rho' \hat{u}'(\rho')}{U_0} \) the elasticity of unemployment with respect to benefits.
The expression of the disincentive effect, \( \hat{u}'(\rho') \), is provided in the following proposition:

**Proposition 3.2.** At the equilibrium, the impact on unemployment of a marginal deviation in the replacement rate (the disincentive effect), \( \hat{u}'(\rho') \), is:

\[
\hat{u}'(\rho') = \lambda \left[ \beta w \left( u'(\rho'w) + \frac{\hat{u}(\rho')}{1-\hat{u}(\rho')} u'(w(1 - \tau(\rho', \hat{u}(\rho')))) \right) \right. \\
\left. \frac{g''(1 - \hat{u}(\rho')) - \frac{\beta p'w}{(1-\hat{u}(\rho'))^2} u'(w(1 - \tau(\rho', \hat{u}(\rho'))))}{g''(1 - \hat{u}(\rho'))} \right]
\]  

(5)

with \( g''(1 - \hat{u}(\rho')) - \frac{\beta p'w}{(1-\hat{u}(\rho'))^2} u'(w(1 - \tau(\rho', \hat{u}(\rho')))) > 0 \) for \( \rho' = \bar{\rho} < \rho_{\text{max}} \), \( \rho_{\text{max}} \) being the highest replacement rate compatible with an unemployment rate \( \hat{u}(\rho') < 100\% \).

**Proof.** The proof consists of two different parts. The first part derives the above-mentioned expression and is detailed in the Online Appendix A.2.2. The second part proves that there exists an upper bound for the replacement rate \( \bar{\rho} \) below which agents exert a positive search effort (otherwise, nobody would search and no production would take place in this economy). It is detailed in the Online Appendix section A.1, as one of the properties of the stationary model.

Importantly, the impact of \( \lambda \), the persistence of an initial deviation in the replacement rate, is unambiguous: the higher \( \lambda \) is, the higher is the disincentive effect \( \hat{u}'(\rho') \). In other words, a given marginal deviation in \( \rho' \) will have a stronger impact on the future unemployment rate when the deviation is expected to last longer. Indeed, a marginal increase in the replacement rate will affect the search effort insofar as it reduces the gain in utility from being hired. A higher value for \( \lambda \) means a higher probability that the marginal increase in \( \rho' \) will be maintained at the next date. This mechanism materialises as a proportionate effect of \( \lambda \) on \( \hat{u}'(\rho') \).

Using equation (5) and imposing \( \hat{u}(\rho') = U_0 \) at the equilibrium, the above Baily-Chetty condition can be rewritten as follows:

\[
\frac{u'(\rho'w) - u'(w(1 - \tau(\rho', U_0))}{u'(w(1 - \tau(\rho', U_0))} = \lambda \left[ \frac{\rho' \beta^2 w \left( \frac{u'(\rho'w)}{U_0(1-U_0)} + \frac{u'(w(1-\tau(\rho', U_0)))}{(1-U_0)^2} \right)}{g''(1 - U_0) - \frac{\beta p'w}{(1-U_0)^2} u'(w(1 - \tau(\rho', U_0)))} \right]
\]  

(6)

Each part of the above relation depends on the replacement rate \( \rho' \) and the initial unemployment rate \( U_0 \). Recall that at the equilibrium, \( U_0 \) is the only unemployment rate consistent with the long-run constant replacement rate \( \bar{\rho} \): at date \( t = -1 \), all households expect the future replacement rate to be \( \bar{\rho} \) and exert search effort resulting in the time \( t = 0 \) unemployment rate \( U_0 \). \( U_0 \) is, thus, itself a function of \( \bar{\rho} \) and we
As we are only interested in characterising the equilibrium, we have already imposed that $\rho' = \bar{\rho}$.\(^9\) This implies that equation (6) depends only on the replacement rate $\rho'$.

The LHS of (6) is unambiguously decreasing in $\rho'$ (and trivially continuous): as $\rho'$ increases, the marginal utility of the unemployed diminishes and the unemployment rate increases.\(^11\) In turn, the after-tax wage drops and the marginal utility of the employed increases. In particular, the LHS becomes arbitrarily high as $\rho'$ approaches 0. Finally, recall that there exists an upper bound on the replacement rate, above which no production takes place.

In the general case, the RHS of (6) is non-monotonous. It is therefore not possible to prove the uniqueness of the equilibrium. However, we can prove that at least one stable equilibrium exists and that uniqueness is guaranteed when a certain condition on the function $g(\pi)$ is met.

**Proposition 3.3.** For $\lambda > 0$, there exists at least one interior value $\rho' \in ]0; \rho^{\text{max}}[$ solution of (6).

*Proof.* See Online Appendix A.2.3.\hfill \square

**Proposition 3.4.** A sufficient condition for the existence and the uniqueness of the equilibrium, regardless of the value of $\lambda > 0$, is $(1 - \pi)g'''(\pi) > g''(\pi)$, $\forall \pi, 0 \leq \pi \leq \bar{\pi}$.

*Proof.* See Online Appendix A.2.4. In particular, the condition guarantees that the solution of the necessary first-order condition obtained in Proposition 3.1 is indeed a global maximum.\hfill \square

**Proposition 3.5.** When the solution to equation (6) is unique, a marginal increase in $\lambda$ results in a reduction of the replacement rate.

*Proof.* See Online Appendix A.2.5.\hfill \square

\(^9\)Note that $\hat{u}(\rho')$ describes the impact of a temporary deviation of the replacement rate $\rho'$ (for a given $\bar{\rho}$), while $Y(\bar{\rho})$ describes the impact of a constant (permanent) replacement rate.

\(^10\)As shown in the Online Appendix section A.1, there exists only one stable equilibrium for a given replacement rate $\bar{\rho}$ expected with certainty.

\(^11\)Here we have $U_0 = Y(\bar{\rho}) = Y(\rho')$ and intuitively, the unemployment rate is an increasing function of the replacement rate: $\frac{dY(\bar{\rho})}{d\rho'} > 0$. 

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3.2.3 Numerical illustration of the impact of persistence

Figure 2 provides a numerical illustration of the impact of the persistence of the initial deviation $\lambda$ on the equilibrium replacement rate. We adopt the following functional forms: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$ with $\gamma = 2$, and $g(\pi) = A \left( \frac{1}{\xi} ln \left( \frac{\pi}{\pi-\bar{\pi}} \right) \right)^\psi$ for disutility of effort. We impose $A = 0.01, \psi = 3.0, \xi = 1.5, \pi = 0.97, \beta = 0.98$. The Figure plots the curves for the LHS and the RHS of equation (6), for various values of $\lambda$. In this specific case, the RHS is monotonously increasing and the equilibrium is unique. The longer the initial deviation is on average (i.e., the higher is $\lambda$), the lower the equilibrium replacement rate is. In particular, with $\lambda$ arbitrarily small, the equilibrium approaches $\rho^{\text{max}}$, the highest replacement rate compatible with some agents being employed.

![Figure 2. Numerical illustration of the impact of the persistence of the initial deviation $\lambda$ on the equilibrium replacement rate.](image)

3.2.4 Disentangling insurance, disincentive, and redistributive effects

Several mechanisms are simultaneously at work in this setting: insurance, disincentive, and redistribution. We distinguish insurance and redistribution in the following manner. Insurance takes place ex-ante, reallocating value from high to low-income agents while having been properly anticipated. RedISTRIBUTION takes place ex-post, operating the same type of reallocation but without having been anticipated. The disincentive effect is simply the impact on the future unemployment rate of current

\footnote{This specification can be better understood by introducing search effort $s$ as an intermediary variable. It indeed derives from a disutility of effort $g(s) = A s^\psi$ and an unemployment exit rate $\pi(s) = \pi(1 - e^{-\xi s})$.}
effort. An unexpected shock on date \( t = 0 \) unemployment benefits is redistributive, but it exerts no disincentive, as the current unemployment rate is predetermined. Disincentive and insurance effects accrue in the future. We now detail the impact of the persistence of the initial deviation \( \lambda \) by disentangling the above effects.

The equilibrium replacement rate balances the current redistributive gains with the future impact of a marginal deviation of the replacement rate. The global future impact is defined as the discounted sum of the impacts on expected utility at each of the future dates at which the deviation takes place. Conditional on the deviation still carried on at date \( T \), the future marginal effect, noted \( F^\lambda_T \), at date \( T - 1 \) writes:

\[
F^\lambda_T(\rho') = \frac{d}{d\rho'} \left[ -g(\pi_T) + \beta \left( \lambda \left( \pi_T u(w(1 + \tau(\rho', \tilde{u}(\rho')))) + (1 - \pi_T) u(\rho'w) \right) \\
+ (1 - \lambda) \left( \pi_T u(w(1 - \tau(\tilde{u}(\rho')))) + (1 - \pi_T) u(\tilde{u}w) \right) \right] \\
= \lambda \beta \left\{ \tilde{u}(\rho')w(u'(\rho'w) - u'(w(1 - \tau(\rho', \tilde{u}(\rho'))))) \right\} - \frac{\rho' w u'(\rho')}{\lambda (1 - \tilde{u}(\rho'))} u'(w(1 - \tau(\rho', \tilde{u}(\rho'))))
\]

In the last expression, the term inside curly brackets corresponds to the insurance gains of a marginal increase in the replacement rate at any date, not only the next one, conditional on being implemented.\(^{13}\) The disincentive costs correspond to the next term. Increasing unemployment benefits raises the unemployment rate, which translates into a tax increase paid exclusively by employed agents. Similarly, we define \( F_T(\rho') \) as the marginal effect of an upward deviation of the replacement rate evaluated at date \( T - 1 \) when this deviation is maintained at date \( T \) for sure. We have \( F^\lambda_T(\rho') = \lambda F_T(\rho') \)\(^{14}\) and \( \forall T' \neq T, F_{T'}(\rho') = F_T(\rho') = F(\rho') \): the marginal effects at different dates are equal. Thus, the global future marginal effect seen from date \( t = 0 \) is simply:

\[
\sum_{t=1}^{\infty} (\beta \lambda)^{t-1} F^\lambda_T(\rho') = \sum_{t=1}^{\infty} (\beta \lambda)^{t-1} \lambda F(\rho') = \frac{\lambda}{1 - \beta \lambda} F(\rho')
\]

The pure redistributive gains of a benefit increase at date \( t = 0 \), noted \( R_0(\rho') \)

\(^{13}\)In this stylized setup where employed and unemployed individuals face the same employment prospects, the insurance gains exactly correspond to the impact of a marginal increase in \( \rho' \) on the utilitarian criterion while keeping the unemployment rate constant.

\(^{14}\)We can easily get \( F_T(\rho') \) from \( F^\lambda_T(\rho') \) by imposing \( \lambda = 1 \). Then, from equation (5), we know that \( \tilde{u}'(\rho') \) is proportional to \( \lambda \): the term \( \frac{\rho' \tilde{u}'(\rho')}{\lambda (1 - \tilde{u}(\rho'))} \) is, thus, independent from \( \lambda \) and in turn the whole term inside the bracket in (7) as well. We conclude that \( F^\lambda_T(\rho') = \lambda F_T(\rho') \).
are:
\[ R_0(\rho') = \hat{u}(\rho')w(u'(\rho'w) - u'(w(1 - \tau(\rho', \hat{u}(\rho'))))) \]

At the optimal public choice, the sum of all marginal effects is equal to zero:
\[ R_0(\rho') + \frac{\lambda}{1 - \beta \lambda} \mathcal{F}(\rho') = 0 \]

As instantaneous redistributive gains always occur with \( R_0(\rho') > 0 \), it has to be that the sum of future marginal effects is negative. They are consequently future marginal costs. The government can, thus, take advantage of redistributive gains up to the point where an increase in the replacement rate generates future marginal costs exactly balancing the instantaneous marginal gains.

The expected duration of the public choice affects the equilibrium because, at the optimal public choice, the total marginal effect will depend on how long the future costs are suffered. If the public choice is expected to last longer, the total future costs of any replacement rate increase will be larger, so the public authority will opt for a lower replacement rate. In the end, this is driven by the fact that the pure redistributive gains occur for exactly one period, while the future costs will take place for a variable length of time. In the limit case where \( \lambda = 0 \), a pure redistribution is operated at \( t = 0 \), with no impact whatsoever on the search effort of agents. From condition (3), noticing that \( \hat{u}'(\rho') = 0 \) in this case, it is clear that the after-tax income will be perfectly equated between the employed and the unemployed. This, in turn, implies that agents have no incentive to search so that in this economy, all agents remain unemployed.

To isolate this redistributive channel, we finally discuss an alternative economy where the choice is undertaken and announced at date \( t = 0 \) but implemented (with certainty) only at date \( t = 1 \). From \( t = 2 \) on, the policy is sustained with probability \( \lambda \). In this economy, the pure redistributive impact is, thus, offset and there are only

---

15 One can notice that the insurance and the redistributive effects are formally identical. As explained, they are only distinguished by the fact that insurance takes place \textit{ex-ante}, while redistribution, operated as a surprise at date \( t = 0 \), takes place \textit{ex-post} without having been anticipated at the previous date.

16 We can prove this as follows. Notice that expression (7) can be further simplified as:
\[ \mathcal{F}_t^\delta(\rho') = \beta \lambda \hat{u}(\rho')u'(w(1 - \tau(\rho', \hat{u}(\rho'))))w \left[ \frac{u'(\rho'w) - u'(w(1 - \tau(\rho', \hat{u}(\rho'))))}{u'(w(1 - \tau(\rho', \hat{u}(\rho'))))} - \frac{\rho' \hat{u}'(\rho')}{\lambda \hat{u}(\rho')(1 - \hat{u}(\rho'))} \right] \]

and that formally \( \hat{u}(\rho') = U_0 \). When condition (3) is verified, the bracketed term in the previous expression is, thus, negative. This implies that \( \mathcal{F}(\rho') < 0 \).
anticipated effects: we call it the no surprise economy in contrast to the initial economy above. We show in the Online Appendix section A.3 that the optimal choice, in this case, satisfies another version of the Baily-Chetty condition:\footnote{It is straightforward to show that proposition (3.4) is also a sufficient condition for the existence and uniqueness of the equilibrium in the no surprise economy.}

\[
\frac{u'(\rho'w) - u'(w(1 - \tau(\rho', U_0)))}{u'(w(1 - \tau(\rho', U_0)))} = \frac{\rho' \hat{u}_{\lambda=1}(\rho')}{U_0(1 - U_0)}
\]  

(8)

This optimality condition is independent of \( \lambda \), although \( \lambda \) affects the expected duration of the policy choice, and displays the optimal trade-off between insurance and disincentive effects absent any redistributive margin.\footnote{In this case, as the policy applies with certainty at \( t = 1 \), the actual marginal effect of a change in \( \rho' \), \( \hat{u}'(\rho') \), is derived from equation (5) with \( \lambda = 1 \). In fact, the same condition would appear for a policy chosen at date \( t = 0 \) and implemented with certainty only at date \( t = 1 \) and never again (or alternatively implemented with certainty from date \( t = 1 \) to any known terminal date \( t_{\text{final}} \)).} Qualitatively, the RHS of equation (8) (the increasing curve) is higher in the no surprise economy than in the initial economy: the equilibrium is associated with a lower replacement rate than in the initial economy.\footnote{The RHS of (8) is equal to the RHS of (3) divided by \( \beta \lambda \), so it is clearly larger.} Formally, the total effect of a marginal replacement rate increase is \( \frac{\lambda}{1 - \beta \lambda} F(\rho') \) in this economy. The optimality condition, balancing insurance and disincentive effects, writes:

\[
\frac{\lambda}{1 - \beta \lambda} F(\rho') = 0 \iff F(\rho') = 0
\]

This optimality condition is the same, whether it is imposed over the whole expected time span or for a single period.

4 The time-consistent case

In this time-consistent setting, we relax a number of the restrictive assumptions of the previous analytical model. A fully time-consistent equilibrium is introduced with repeated choices and initial equilibrium characterisation. The labour market is typical with unemployment persistence. We analyse the partial equilibrium in a Bewley (1986)-Huggett (1993)-Aiyagari (1994) economy. The government sets the UI replacement rate in order to maximise social welfare. This behaviour, called policy, describes the political problem of choosing sequentially in time a current period optimal replacement rate.
4.1 Model specification and parameterization

4.1.1 Households

The economy is populated by a continuum of \textit{ex-ante} identical infinitely lived households of unit mass. Their preferences, assumed to be additively separable over time, are summarised by \( V = E_0 \left\{ \sum_{t=0}^{\infty} \beta^t v(c_t, s_t) \right\} \) with \( v(c_t, s_t) = \frac{c_t^{1-\sigma}}{1-\sigma} - s_t^\xi, \xi > 1 \) where \( \beta \) is the discount factor, \( \sigma \) is the relative risk aversion, \( c \) is current consumption and \( s \) is the search effort when unemployed.\(^{20}\) Employed agents have status \( \varepsilon = e \) on the labour market while unemployed have \( \varepsilon = u \). The unemployment exit rate is: \( \pi(e_{t+1} = e|\varepsilon_t = u) = 1 - \exp(-\kappa s) \), with \( \kappa \) an exogenous parameter. Employed agents face a constant exogenous job destruction rate \( \delta \).

The recursive formulation of the household’s program is:

\[
V(a, \varepsilon, \Psi, \rho) = \max_{c > 0, \ a' \geq a_{\text{min}}, \ s \geq 0} v(c, s) + \beta EV(a', \varepsilon', \Psi', \rho')
\]

s.t. \( a' + c = (1 + r)a + y(\varepsilon, \rho)(1 - \tau(\rho, U)) \)

\[
\Psi' = \Gamma(\Psi, \rho)
\]

\[
U' = U(\Psi)
\]

\[
\rho' = \Phi(\Psi') \quad \text{with probability } \lambda \quad \text{and } \rho' = \rho \quad \text{with probability } (1 - \lambda)
\]

\[
y(\varepsilon, \rho) = w \quad \text{and} \quad y(u, \rho) = \rho w
\]

\( a \) is the agent’s private financial asset level, \( r \) and \( w \) are exogenous prices, \( \rho \) the replacement rate, \( U \) the current unemployment rate, and \( \tau \) the tax rate. \( \Psi \) (resp. \( \Psi' \)) denotes the current (resp. future) measure of agents over asset holdings and employment status. \( \Gamma \) is the law of motion between two such consecutive measures. \( \Phi \) is a function describing the choice process of the government with respect to the replacement rate. \( \lambda \) is the probability that a new replacement rate is chosen at every date.\(^{21}\) The optimal search effort \( s \) is such that the following equation is satisfied:

\( \xi s^{\xi-1} = \kappa e^{-\kappa s} (\beta E[V(a', e, \Psi', \rho') - V(a', u, \Psi', \rho')]) \).

\(^{20}\)The search effort only influences the unemployment exit rate and does not apply to the employed agent who will trivially provide an effort \( s = 0 \).

\(^{21}\)\( \lambda \) here is related but different from the one in the analytical model. Here, if \( \lambda < 1 \), the current replacement rate will, with some probability, last more than a single period. Therefore, \( \rho \) is a state variable.
4.1.2 The dynamic game of the benevolent social planner

The government runs a UI system and levies taxes to fund it. We assume that labour and replacement incomes are taxed at a proportional rate $\tau$. The government budget constraint is $\rho_t w U_t = \tau_t (w (1 - U_t) + \rho_t w U_t)$.

At the beginning of each date, the government chooses a new replacement rate with probability $\lambda$. This policy will only last until the next choice as no commitment technology is available. Thus, the government can be seen as playing a game against its future self since it has no control over future choices. As future government choices are exogenous to both the agents and the government, they can be regarded as reaction functions. In the end, the social planner sets today the replacement rate for the subsequent periods by maximising the following utilitarian welfare criterion:

$$ \Phi(\Psi) = \arg \max_{\tilde{\rho}} \sum_{\epsilon \in \{e, u\}} \int_{d_{\text{min}}}^{d_{\text{max}}} V(a, \epsilon, \Psi, \tilde{\rho}) \Psi(a, \epsilon) da $$

4.1.3 The politico-economic equilibrium

The recursive equilibrium is characterised by the vector:

$$ [a'(a, \epsilon, \Psi, \rho), s(a, u, \Psi, \rho), V(a, \epsilon, \Psi, \rho), \Gamma(\Psi, \rho), \Phi(\Psi)] $$

such that:

1. Given the law of motion $\Gamma(\Psi, \rho)$ and the choice rule $\Phi(\Psi)$, $V(a, \epsilon, \Psi, \rho)$ is the value function solution to the program (9), $a'(a, \epsilon, \Psi, \rho)$ the associated savings rule, and $s(a, u, \Psi, \rho)$ the associated effort,

2. Given the rules $a'(a, \epsilon, \Psi, \rho)$ and $s(a, u, \Psi, \rho)$, and for any state of the economy $(\Psi, \rho)$, next period’s distribution of agents, $\Psi'$, implied by the savings and effort rules, is consistent with the expected law of motion $\Gamma(\Psi, \rho)$,

3. Given the above value function, the maximisation of the utilitarian criterion at each date is consistent with the expected choice rule $\Phi(\Psi)$.

Solving for the equilibrium above is intractable as the distribution of agents belongs to a set of infinite dimension. We explain our solution algorithm in section B5 of the Online Appendix.
4.1.4 Parameterisation

The benchmark parameterisation targets the quick flows on the US labour market with a model periodicity of three weeks. We focus on the segment of low-qualified workers, prone to be the main target of UI policies. Precisely, we have to set values for $\sigma, \beta, \xi, \kappa, \delta, r$ and $w$. Without any loss of generality, the wage rate $w$ can be normalised to 1. The relative risk aversion $\sigma$ is set to 2. The model interest rate is $r = 0\%$ to provide a good approximation of the real return on assets detained by the fraction of the population we are considering. For the most part, these assets are low or no-return bank accounts.

As we only consider a precautionary saving motive, it would be fair to expect a low simulated average financial wealth. With income risk, the combined values of the discount factor $\beta$ and the interest rate $r$ determine the incentive to save. Therefore, the average financial wealth held will affect the ability of agents to self-insure and influence the optimal trade-off of the government. It follows that the quantification of $\beta$ and $r$ is key. We use 2007 data from the Survey of Consumer Finances (SCF) to compute the average liquid asset of low-skilled workers and obtain an empirically relevant parameterisation of the discount factor. In our SCF computations, the average per capita liquid financial asset of the population we consider is 2926 $. This is about 2.6 times the model-period income of said population.\textsuperscript{22} With this target, we find a discount factor of 0.9945.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w$</td>
<td>1</td>
<td>Wage (normalisation)</td>
</tr>
<tr>
<td>$r$</td>
<td>0%</td>
<td>Quarterly interest rate</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.9945</td>
<td>Discount factor</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>2</td>
<td>Relative risk aversion</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.0133</td>
<td>Job destruction rate</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>0.2149</td>
<td>Exit rate parameter</td>
</tr>
<tr>
<td>$\xi$</td>
<td>1.9391</td>
<td>Effort function curvature</td>
</tr>
<tr>
<td>$a_{min}$</td>
<td>0.0</td>
<td>Borrowing limit</td>
</tr>
</tbody>
</table>

Table 1. Benchmark parameterization values

$\xi, \delta$ and $\kappa$ directly affect the search intensity of unemployed agents. Their calibration is, therefore, based on key quantitative properties of the US labour market for low-qualified workers. We intend to reproduce (i) the unemployment rate of such workers, (ii) the average unemployment duration, and (iii) the elasticity of unemployment.

\textsuperscript{22}Following the Bureau of Labor Statistics, the weekly first quartile income of high-school graduates and less is 376 $. In model period, this value becomes 1128 $.
ment duration with respect to the replacement rate. We use the Current Population Survey to compute values for the first two elements. The unemployment rate for less than high-school graduates was 6% over 2000-2007 and 8.2% over 2011-2018. We retain an average value of 7% for this fringe of the population. The unemployment duration is about 17 weeks in the data. Given the unemployment rate and duration, we deduce the average employment duration, implying a job destruction rate $\delta$ of 0.0133. Finally, various estimates of the elasticity of unemployment duration relative to the replacement rate do not establish a consensus. Studies report a value in the 0.1 to 1.0 range in the US and in the 0.3 and 2.0 range in Europe.\footnote{See our Online Appendix section B.4.3 and Card et al. (2015) and Card et al. (2015) for a discussion.} Following Landais (2015), we target a value of 0.4. We find that with $\xi = 1.9391$ and $\kappa = 0.2149$, we match the above-mentioned targets.

4.2 Utilitarian welfare criterion

4.2.1 Equilibrium replacement rate and choice periodicity

In this section, we discuss the replacement rate corresponding to a stable equilibrium.\footnote{The characterisation of this politico-economic equilibrium is interesting in itself. However, for the sake of concision, we discuss the choice rule, laws of motion, and detailed dynamics leading to this equilibrium in sections B.1 and B.2 of the Online Appendix.} Table 2 reports the impact the expected duration of the replacement rate has on its level. We consider different choice periodicities as alternative options for how often a policy is revised. One and four years are natural benchmarks as they align with budget cycles or general election agendas in the US and other countries. Alternative periodicities are obtained by adjusting $\lambda$.

<table>
<thead>
<tr>
<th>Choice periodicity (years)</th>
<th>1/4</th>
<th>1</th>
<th>4</th>
<th>10</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement rate (%)</td>
<td>70.8</td>
<td>63.1</td>
<td>60.5</td>
<td>59.9</td>
<td>59.7</td>
</tr>
<tr>
<td>Unemployment rate (%)</td>
<td>10.7</td>
<td>9.3</td>
<td>8.9</td>
<td>8.8</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Table. 2. Effect of the policy duration on the replacement and unemployment rates in a time-consistent setting

We first find that a positive and high replacement rate is sustained in this economy. The mechanisms taking place contrast with those in long-run models (as in Hansen and İmrohoroğlu (1992)) or in models where a single transition between two steady-states is implemented (as in Joseph and Weitzenblum (2003) or Young (2004)). Here,
the government re-optimises over time and reconsiders the trade-off it faces each time a choice is operated. On the one hand, when starting from a high replacement rate and reducing it, long-run gains from lower unemployment and higher asset accumulation appear. On the other hand, short-run costs arise: a lower level of public insurance prompts more self-insurance and consumption cuts. The new mechanism here is that both the government and agents take the limited duration of the current choice into account.

Table 2 shows that both the optimal time-consistent replacement rate and the unemployment rate unambiguously and monotonically increase as the choice periodicity becomes shorter. Conversely, when the periodicity is long—typically 25 years or more—the replacement rate aligns with that of an economy with a commitment device. The fact that shorter periodicities lead to higher replacement rates can be explained by a combination of mechanisms encompassing all those of the analytical model. In particular, when the new replacement rate immediately applies, it comes as a surprise and its current level exerts no disincentive effect, contrary to future ones. When the choice periodicity gets shorter, this redistributive gain, although effective for a single period, gets higher, relative to the net impact (insurance gains minus disincentives costs) applying to future dates. This alone would already make the equilibrium replacement rate a decreasing function of the choice periodicity. However, another channel, absent from the analytical model, also causes the replacement rate to be dependent on the choice periodicity.

4.2.2 Insurance and disincentive effects: another channel

In order to disentangle the effects on unemployment and welfare of replacement rate policies differing in their durations and characterise the new channel, we perform experiments resting on simpler dynamics than in the benchmark model. Namely, we consider deterministic temporary marginal increases in the replacement rate and adjust our notations accordingly. The transitional dynamics are characterised as follows: (i) the initial state of the economy consists of the distribution of agents $\Psi_0$ consistent with the replacement rate $\rho$ being indefinitely imposed in the past, (ii) at date $t = 0$, a marginal increase in the replacement rate of magnitude $\Delta \rho$ is chosen and announced, it is effective only from date $t = 1$ on and lasts $S$ periods thereafter. This increase is perfectly anticipated by all agents, (iii) from date $t = S + 1$ on, the replacement rate

$^{25}$In the Online Appendix section C, we compare this result with an equilibrium akin to one with a commitment technology.
reverts back to $\tilde{\rho}$, the initial value.

The recursive formulation of the agents’ program is:26

$$V(a, e, t) = \max_{c > 0, a' \geq a_{\min}} \nu(c) + \beta \left[ (1 - \delta) V(a', e, t + 1) + \delta V(a', u, t + 1) \right]$$

$$V(a, u, t) = \max_{c > 0, a' \neq a_{\min}} \nu(c) - s^2 + \beta \left[ (\pi(s) V(a', e, t + 1) + (1 - \pi(s)) V(a', u, t + 1) \right]$$

$$a' + c = (1 + r)a + y(e, t)(1 - \tau(\rho_t, U_t))$$

$$y(e, t) = w$$ and $$y(u, t) = \rho_t w$$

The dynamics of the economy then consists of $$(\rho_t)_{t \geq 0}, (\tau_t)_{t \geq 0}, (s(a, u, t))_{t \geq 0}, (a'(a, e, t))_{t \geq 0}, (a'(a, u, t))_{t \geq 0}, (\Psi_t)_{t \geq 0}$$ such that: (i) $\Psi_0$ is the only stationary distribution compatible with the replacement rate $\tilde{\rho}$; (ii) given the paths $$(\rho_t)_{t \geq 0}$$ and $$(\tau_t)_{t \geq 0}$$, $a'(a, e, t), a'(a, u, t)$ and $s(a, u, t)$ are the optimal decision rules obtained from the above program; (iii) the sequence of distributions of agents $(\Psi_t)_{t \geq 0}$ is the only one compatible with $\Psi_0$ and the above decision rules. (iv) given the paths $$(\rho_t)_{t \geq 0}$$ and $$(\tau_t)_{t \geq 0}$$ and given the sequence of unemployment rate $$(U_t)_{t \geq 0}$$ obtained from $$(\Psi_t)_{t \geq 0}$$, the budget of the government is balanced at every date.

All other model specifications and parameterisation are identical to the benchmark case. To explain the gains and costs of a marginal increase in the replacement rate, we first search for the initial replacement rate $\tilde{\rho}$ such that an increase of magnitude $\Delta \rho = 2$ percentage points, effective for a single model period (date $t = 1$), leaves unchanged the utilitarian criterion evaluated at $t = 0$.27

We then simulate the transition, starting with the same initial conditions, for various durations $S$. In particular, we focus on the differentiated impact of increases lasting 1 and 2 periods.

Figure 3 displays the unemployment dynamics following the deterministic marginal increase in the replacement rate. It is clear that the cumulated impact on the unemployment rate of an increase lasting 2 periods is considerably higher than twice the impact of an increase lasting one period: the initial unemployment rate increase is

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26We index the value function with time to clearly show this dependence and we expand the conditional expectation revealing the labour market exit and entry probabilities.

27In this setting, the public choice is decided only at $t = 0$ and never repeated thereafter and we specifically search for the initial replacement rate from which no deterministic deviation is worthwhile. In particular, the initial steady state is the only one compatible with the initial replacement rate. Consequently, the impact of marginal deviations is comparable to those at the equilibrium of the complete model with repeated choices.
almost twice as high when $S = 2$, and it keeps increasing at date $t = 2$, whereas it has already started to decrease from date $t = 1$ when the increase ends at $t = 1$. To give a simple insight, consider the case where agents cannot save, such that there are only two types of agents: employed and unemployed. Economically and for marginal variations, the unemployment increase is proportional to the search effort reduction, which itself is proportional to the decrease in welfare gain $V(e, t + 1) - V(u, t + 1)$ generated by the increase in the replacement rate. Ignoring for the purpose of the argument the impact of the unemployment increase on the tax rate and on the after-tax income, the difference $V(e, 1) - V(u, 1)$ diminishes both because the difference in instantaneous utility $u(w(1 - \tau_1)) - u(\rho_1 w(1 - \tau_1))$ falls, and because the future expected difference $u(w(1 - \tau_2)) - u(\rho_2 w(1 - \tau_2))$ falls too. This latter term is discounted by $\beta(1 - \delta - \pi(s_1))$ to account for the fact that, as seen from $t = 0$, the gain is all the smaller, as the agent may find a job at $t = 2$ (with probability $\pi(s_1)$). Consequently, the search effort reduction at date $t = 0$ is driven by the two consecutive replacement rate increases. At date $t = 1$, only the replacement rate increase effective at the next date affects the search effort. As seen from date $t = 0$, the increase in $\rho$ at $t = 2$ doubly affects the unemployment rate while the increase at $t = 1$ affects it only once. The marginal gains in terms of higher insurance (reduction in the gap of marginal utilities) roughly double when the increase lasts two periods, ignoring the impact of the marginal increase in $\rho$ on the unemployment rate, and the discount factor $\beta$. 

Figure 3. Unemployment rate dynamics
Therefore, the marginal disincentive costs increase more than proportionately with the duration, while the marginal gains are approximately proportional to the duration. As the duration increases, marginal costs increase faster than gains. In the example in Figure 3, the initial state corresponds to a maximal utilitarian criterion for an increase lasting 1 period. This means that the marginal gains and costs exactly offset each other. If the increase lasts 2 periods, the marginal costs become larger than the marginal gains. The net impact on the utilitarian criterion would be negative, and on the opposite, a replacement rate reduction would be beneficial. The current replacement rate would then be too high if the increase were to last 2 periods instead of one.\footnote{Note that the additional channel here is independent of whether agents can save or not. The experiments above can be reproduced in a model without the savings margin with the same qualitative conclusions.}

4.3 Median voter criterion

As a comparison to the utilitarian case, we now consider the following median voter criterion to set the replacement rate:

$$
\Phi(\Psi) = \arg \max_{\tilde{\rho}} V (a_{med}, \epsilon, \Psi, \tilde{\rho}),
$$

$a_{med}$ is the level of financial wealth such that 50\% of the population is employed and has at least that level of assets. $\tilde{\rho}$ then applies to the economy.

The results, reported in Table 3, are driven by the fact that the median voter here is employed and comparatively rich, with very different incentives from those emphasised in the utilitarian setting. The economy still sustains positive replacement rates but are lower than those in our benchmark. Importantly, the equilibrium replacement rate still depends on the choice periodicity. However, here, it increases with the choice periodicity. These results are intuitive and in line with the classical results in Wright (1986). With a short choice periodicity, the median voter has a strong probability of remaining employed between two policy changes. Thus, she is not willing to pay for an increase in the replacement rate that she will most likely not benefit from. Therefore, over short time horizons, she favours lower replacement rates. If the choice periodicity is long, the median voter is aware that, with a higher probability, she may become unemployed before the next policy change takes place. She, consequently, favours higher replacement rates. The purely redistributive effect is not effective here.
as the median agent is currently working. She views unemployment benefits as only a cost at the time of the policy choice.

<table>
<thead>
<tr>
<th>Choice periodicity (years)</th>
<th>1</th>
<th>4</th>
<th>10</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement rate</td>
<td>43.2</td>
<td>55.0</td>
<td>57.0</td>
<td>57.6</td>
</tr>
<tr>
<td>Unemp. rate</td>
<td>7.2</td>
<td>8.3</td>
<td>8.5</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Table. 3. Characteristics of the time-consistent model with a median voter

4.4 The importance of savings

To underline the importance of the savings margin, we compare our benchmark model to a case where savings are precluded in Table 4. We note that both the optimal time-consistent replacement rate and the unemployment rate are always higher in the model without savings. This difference can be explained by the traditional private versus government insurance channel. In a world without private savings, the government-run UI system provides the only means of insurance against unemployment risk. However, once agents have access to an (even incomplete) asset market, they will engage in precautionary savings in order to smooth consumption and therefore will increase their insurance against unemployment risk on their own. This will lower the need for government insurance. The replacement rate gap due to savings is quite significant at all choice periodicities.

<table>
<thead>
<tr>
<th>Choice periodicity (years)</th>
<th>1/4</th>
<th>1</th>
<th>4</th>
<th>10</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement rate (%)</td>
<td>82.5</td>
<td>75.2</td>
<td>72.5</td>
<td>71.9</td>
<td>71.7</td>
</tr>
<tr>
<td>Unemployment rate (%)</td>
<td>10.8</td>
<td>9.8</td>
<td>9.5</td>
<td>9.4</td>
<td>9.4</td>
</tr>
</tbody>
</table>

Table. 4. Effect of the policy duration on the replacement and unemployment rates in a time-consistent setting without savings

In the Online Appendix section B2, we provide a decomposition of the dynamics of the model and explain how exactly the unemployment rate and the accumulation behaviour of agents enter in the determination of the time-consistent equilibrium. Policywise, this decomposition shows how the interplay between private savings and unemployment might prevent a government from making drastic adjustments to its UI policy and, all other things equal, how it might take time and several governments to reach an optimal policy when starting away from it. In the Online Appendix section B3, we further discuss the implications of savings for our equilibrium.
5 Concluding remarks

In this paper, we develop both an analytical and a fully time-consistent quantitative model to characterise the relation between the equilibrium UI replacement rate and its choice frequency. The absence of a commitment device produces interplays among the government, its future self, and the economic agents with respect to the UI policy. The incentive for a government to provide more or less UI is dependent on the choice frequency. Furthermore, this relation is contingent on the political process used and the existence of an asset market. These elements cannot be captured in a world where choices are not repeated and commitment is assumed.

References


