Measuring Unemployment Insurance Generosity: Replication and Corrigendum†

Fernando Barros Jr.*
Department of Economics,
FEARP-USP – Brazil

Marcos J. Ribeiro
Department of Economics,
FEARP-USP – Brazil

César F. Sousa
Petrobras – Brazil

November 16, 2024

Abstract

This paper refines the results of Pallage et al. (2013), focusing on the generosity of unemployment insurance programs. We maintain the core structure of their method while addressing subtle discrepancies in their numerical simulations and introducing additional considerations. We conduct a three-stage computational analysis, replicating their results, refining the convergence criterion, and introducing the leisure cost of working into the numerical simulations. Our findings indicate that the generosity of the program in the UK is both higher and exhibits a smoother trend than previously estimated.
Keywords: Unemployment Insurance; Social Security; Labor Market. **JEL Classifications**: C32, E21, E32.

Declarations

Availability of data and material: Replication files can be found HERE.

Funding: This research was carried out with the support of Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Financing Code 001. Fernando Barros Jr thanks CNPq-Brazil for partial financial support. Marcos Ribeiro thanks FAPESP for partial financial support, grant number 2024/06763-0.

Authors' contributions: Barros Jr.: Conceptualization, Writing, Coding. Ribeiro: Writing, Revision. Sousa: Conceptualization, Writing, Code.

Acknowledgements: We thank Luiz Brotherhood and Janaína Feijó for their helpful comments. The remaining errors are our own.

Conflict of interest: We have no conflict of interest to disclosure.

†The opinions expressed here are only those of the authors and do not necessarily represent the opinions of Petrobras.

*Corresponding Author. Email: fabarrosjr@usp.br

1 Introduction

Unemployment insurance (UI) programs are complex to evaluate because they are characterized by various factors, including benefit amount, duration, asset tests, waiting time, and more. Moreover, the perceived value of these programs to workers is contingent upon the prevailing economic conditions. A more generous unemployment insurance program is particularly appreciated during periods of limited job opportunities. Additionally, these programs exhibit variability across both space and time, making it challenging to gauge their generosity accurately. Comparisons between programs from different countries or tracking the evolution of a country's program over time present intricate challenges.

In an important contribution, Pallage et al. (2013), hereafter PSZ, introduces a methodology designed to address the intricate challenges associated with measuring and comparing the generosity of unemployment insurance programs. PSZ devises a novel approach aimed at quantifying the generosity of these programs using a unified metric. They construct an initial model that encapsulates all the complexities inherent in unemployment insurance policies. This model incorporates heterogeneous agents facing liquidity constraints but possessing the ability to self-insure. Subsequently, PSZ develops a second model identical to the first in most respects, with a key distinction: the unemployment insurance policy is simplified to be one-dimensional, devoid of waiting periods, eligibility limits, or asset tests, but featuring constant benefits. The objective is to determine the level of benefits in this streamlined model that renders society indifferent between the two policies. They call the parameter that adjusts as *Generosity*. Finally, PSZ applies this measurement strategy to evaluate the unemployment insurance program of the United Kingdom.

Our study aims to refine some results presented by PSZ, address subtle nuances in their numerical simulations, and introduce additional considerations. We begin by examining the utility function employed by PSZ, which is imported from the work of Hansen and Imrohoroğlu (1992). We observe a subtle change in the utility function used in PSZ's work compared to the one described in Hansen and Imrohoroğlu (1992). Additionally, we notice that their numerical approach omits a normalization step, which involves subtracting 1 from the utility equation. While this adjustment likely does not alter the overarching conclusions, our analysis reveals an inconsistency in applying this normalization in PSZ's code. Consequently, our simulations utilize the original utility function, shedding light on the potential implications of this discrepancy.

A further scrutiny of PSZ's work reveals an additional factor in their model related to the leisure cost of working. Inconsistencies in accounting for this cost in their numerical simulations have notable consequences for the model's equilibrium. We address this by incorporating the leisure cost into our algorithm, enhancing the fidelity of our computational results.

Our computational work unfolds in three stages. Initially, we replicate PSZ's results, revealing a slight deviation in outcomes due to the strength of the convergence criterion used in their algorithm. We then enhance the convergence criterion, observing a smoother trajectory in our *Generosity* measure. Subsequently, introducing the leisure cost of working produces a significant shift in the estimated *Generosity*, challenging PSZ's earlier findings and emphasizing the nuanced impact of program features beyond benefit amounts.

Comparing our *Generosity* measure over time with PSZ's, we observe a consistent decline during the 1980s and a subsequent period of stability in the 1990s. While our results align with PSZ's claim of retrenchment during the Thatcher (1979 – 1990) and Tony Blair (1997 – 2007) years, we diverge from their assertion of a positive trend during the John Major years (1990 – 1997). In addition, we find a smoother trajectory for the *Generosity* over time than reported in PSZ.

Finally, we undertake a comparative analysis of the computed economic characteristics throughout our study. This involves contrasting the detailed and simplified models, encompassing both the novel outcomes considering the leisure cost of working and the results obtained by PSZ. The introduction of a leisure penalty for accepting a job offer leads to a reduced share of the workforce being employed. Consequently, this scenario results in a higher number of individuals receiving some benefit, necessitating an increased tax rate to maintain equilibrium in the budget of the social programs.

Recent research suggests that UI affects labor supply and employment. Abraham et al. (2013) and Boone et al. (2021) suggest that greater UI generosity increases reservation wages and reduces hiring. Additionally, Schmieder and Von Wachter (2016) and Stijepic (2021) suggest that generous benefits reduce the urgency to return to the labor market, allowing the search for better jobs, but may increase the duration of unemployment. We show that there is a relationship between generosity, the tax rate, and the number of employed individuals. This dynamic reveals that higher levels of generosity can lead to an increase in the tax burden, which, in turn, negatively impacts employment.

According to Hall and Zoega (2020), UI increases workers' bargaining power, allowing them to negotiate higher wages and shorter hours, leading to more leisure but also higher costs for companies, which reduces hiring and raises unemployment. Other studies, such as Johnston (2021), found that increases in UI taxes on employers after layoffs significantly reduce hiring and employment without affecting layoffs or wages, hindering labor market recovery after downturns. Similarly, Guo (2024) highlights that payroll tax increases can reduce employment growth, particularly impacting young and low-income workers, contributing to higher unemployment rates among these vulnerable groups.

We show that when there is no cost associated with leisure, workers have a greater incentive to accept job offers, as the only motivation is the increase in income. As a result, the taxable base of the economy is larger, allowing the government to maintain a lower tax rate, since more people are employed and contributing to taxes. On the other hand, when the model accounts for the cost of leisure, wealthier individuals, in particular, may choose to reject job offers, as the additional financial benefit may not outweigh the loss of leisure. This reduces the taxable base of the economy, as fewer workers are accepting jobs and thus paying taxes. To compensate for this reduction in the tax base and to ensure that the budget for programs such as unemployment insurance and other social benefits remains balanced, the government needs to increase the tax rate.

Siddique (2023) argues that UI is critical to the labor market because it affects workers' decisions and firms' hiring decisions. Without adequate insurance, workers accept low-quality jobs out of necessity, leading to market polarization and the rise of low-wage jobs, which exacerbates poverty and inequality. Our study contributes to the ongoing dialogue on these programs by highlighting aspects that may impact their evaluation and comparison. By refining PSZ's results, we aim to enrich understanding of the dynamics between program features, taxation, and economic outcomes.

This paper is organized as follows: Section 2 presents the model proposed by PSZ. In Section 3, we discuss the specificities of our approach, comparing it to PSZ's, and additionally introduce the dataset used. Section 4 describes our computational strategy for replicating and producing more concise results. In Section 5, we present the replication of the generosity estimates from PSZ, along with our corrected results and other model indicators, such as taxes and unemployment. Finally, Section 6 concludes the paper.

2 Model

This study builds upon the methodology developed by PSZ, which was employed to measure the Unemployment Insurance (UI) Generosity in the United Kingdom. Specifically, the measurement of the *Generosity* involves comparing two scenarios. In the first scenario, the detailed model is considered, taking into account the specific parameters of an unemployment insurance program - for example: duration, amount, etc. A simulation of this economy is then performed, and the average utility of agents is calculated. In the second scenario, a simplified model is solved, where the unemployment insurance program has only one adjustment parameter, defined as *Generosity*. A simulation is then conducted in which this parameter is adjusted to generate the same average utility found in the first scenario.

We can set a feature vector (employability rate, eligibility requirements, benefit duration, etc.) for the detailed model, while a simplified model uses the simplest form possible, with unemployment insurance being offered to the unemployed individual without any other clauses. Both models consist of a continuum of people, each characterized by their employment status, asset level, and eligibility for unemployment insurance.

Time is discrete, and each period is represented by t. The labor market is modeled as a lottery system, where there may or may not be a job offer for participants. If an offer is made, the individual decides whether to work a certain number of hours, $0 < \widehat{h} < 1$, or not work. Employment is discrete and indivisible in each period, and the decision has a discrete impact on leisure.

Individuals care about their consumption, c_t, and leisure, l_t, which are chosen to maximize their discounted expected utility. Their utility in each period t is represented by $u(c_t, l_t)$, where u is an increasing and concave function in both arguments. Individual wealth, m_t, can be used as self-insurance against adverse shocks, but there is no possibility of borrowing, i.e., $m_t \geq 0$.

Concerning the stochastic labor market, individuals enter a lottery at the beginning of each period that will determine their employment status. The lottery outcome, k_t, for each individual, is $k_t = o$ if a job offer is extended or $k_t = n$ if it is terminated. The probability of receiving a job offer depends on whether the individual had an offer in the previous period. In any case, the agent can accept or reject the job offer. This decision is represented by x_t, where $x_t = 1$ if the job is accepted in period t, and $x_t = 0$ if it is rejected. Each person's output is given by y, which is also their gross and constant income over time.

The savings from one period to another are described as:

$$m_{t+1} = m_t + y_t^d - c_t, \qquad m_t \geq 0 \quad \forall t, \tag{1}$$

where y_t^d, the disposable income, can take one of four values:

$$y_t^d = \begin{cases} (1-\tau)y, & \text{if employed} \\ (1-\tau)y\omega, & \text{if unemployed and in the waiting period for UI} \\ (1-\tau)y\theta, & \text{if unemployed and eligible for UI} \\ (1-\tau)y\psi, & \text{if unemployed and not eligible for UI,} \end{cases}$$

with τ representing the tax rate on income necessary to finance the unemployment insurance program and other social programs, ω is the income when the person loses their job and is in the waiting period to receive UI, ψ another possible social program to which the individual may be entitled when not eligible for UI, and θ represents the value of unemployment insurance. In this model, all income is taxed, including that received from the government (θ, ψ, and ω).

In the simplified model, the person is always eligible, so the variables ω and ψ are not used. In this case, *Generosity* is directly represented by the variable θ. Thus, the potential income in this model is:

$$y_t^d = \begin{cases} (1-\tau)y, & \text{if employed} \\ (1-\tau)y\theta, & \text{if unemployed.} \end{cases}$$

The eligibility of the program is described by several other parameters. The vector α represents the vector of UI parameters, with information such as waiting time, benefit duration, asset ownership, etc. Initially, eligibility will be represented by the vector of variables s_t, where $s_t = e$ if the individual is eligible and $s_t = u$ if ineligible. Eligibility follows a potentially endogenous law of motion, χ, so:

$$s_{t+1} = \chi(s_t).$$

The intertemporal problem of an individual is represented by:

$$[P] \qquad \max E_0 \left[\sum_{t=1}^{\infty} \beta^t u(c_t, l_t) \right]$$

subject to constraint (1),

where leisure is $l_t = 1$ for those not working, and $l_t = 1 - \widehat{h}$ for those working (remember that work is discrete and indivisible, being equal to $\widehat{h}$), and $\beta \in (0, 1)$ is the discount factor that brings future value to present value.

As the problem $[P]$ is quite complex, the equation developed by Bellman (1954) will be used, which allows transforming an infinite-dimensional problem, like $[P]$, into a finite-dimensional one. Thus, instead of looking at the entire infinite future, it is necessary to consider only the current optimal decision and its value function, V, with state variables (m_t, s_t, k_t). The determined value function is unique and equivalent to the maximized value of $[P]$ for any state (m_t, s_t, k_t).

The individual faces two situations. The first when they have a job offer, which requires two decisions: first, whether to accept or reject the job offer; second, how to consume/save given their available income today. The Bellman equation for this situation is described as follows:

$$V(m,s,o;\alpha) = \max_{x} x \left\{ \max_{c,m'} u(c, 1-\widehat{h}) + \beta \int_{(k'|o)} V(m',s',k';\alpha) d(k'|o) \right\}$$
$$+ (1-x) \left\{ \max_{c,m'} u(c,1) + \beta \int_{(k'|o)} V(m',s',k';\alpha) d(k'|o) \right\}$$

subject to
$$m' = m + y^d(s,o,x;\alpha) - c,$$
$$m' \geq 0,$$
$$s' = \chi(s).$$

Similarly, the Bellman equation when the individual does not have a job offer is:

$$V(m,s,n;\alpha) = \max_{c,m'} u(c,1) + \beta \int_{(k'|n)} V(m',s',k';\alpha) d(k'|n)$$

subject to
$$m' = m + y^d(s,n,0;\alpha) - c,$$
$$m' \geq 0,$$
$$s' = \chi(s).$$

After finding the value function resulting from the above maximization, $V(.)$, we can use the optimal decisions for work, $x(m,s,k)$, consumption, $c(m,s,k)$, and savings, $m'(m,s,k)$, to construct the distribution of agents $f(m,s,k)$, which provides, for each state (m,s,k), the proportion of agents characterized by that particular state.

2.1 Equilibrium

The steady-state equilibrium, given by a specific unemployment insurance policy α, is determined by choices of work, assets, and consumption for all individuals, a value function V, an agent distribution f, and a tax rate τ, such that:

1. Agents solve their individual intertemporal problems, given (α, τ) and labor market characteristics;
2. The unemployment insurance agency balances its budget;
3. The distribution of agents is invariant.

2.2 Detailed Unemployment Insurance Program

At this point, the real unemployment insurance program is described in as much detail as possible and allowed by computational limitations. The following components are considered:

1. A waiting period a, during which the worker is not yet considered eligible to receive program benefits if they become unemployed.
2. The duration of eligibility z; that is, the time the individual will be eligible to receive unemployment insurance benefits.
3. The proportion of the previous income that unemployed individuals will receive as a benefit, $\theta(j)$, which may vary during the unemployment period $(j = 1, \ldots, z)$[1].

[1] Although θ is defined as a sequence of values, in our model, the individual will receive a fixed value for all j.

4. The proportion of income that unemployed individuals will receive after losing their eligibility, ψ, for example, through other social programs.

Therefore, the vector of parameters to be calibrated is:

$$\alpha = (a, z, \{\theta(j)\}_{j=1,\ldots,z}, \psi).$$

Or, more simply for our specific case:

$$\alpha = (a, z, \theta, \psi).$$

2.3 Simplified Unemployment Insurance Program

For the simplified model, the following will be considered:

1. The individual will be eligible as soon as they lose their job, with no waiting time, i.e., $a = 0$.

2. Eligibility will have infinite duration, $z = \infty$.

3. Generosity, or the proportion of income the individual will receive through UI, θ

4. Since there will be no other social programs, $\psi = 0$.

Therefore, the simplified unemployment insurance program will have the following parameter vector, which we will map to the detailed UI program:

$$\alpha = (0, \infty, \theta, 0)$$

Or, in a summarized form:

$$\alpha = (\theta).$$

The parameter θ represents the Generosity that is sought to be assigned to the studied unemployment insurance program. This parameter is adjusted so that the average utility equals between the simplified and detailed unemployment insurance models.

3 Data and model adjustments

In our study, we maintain the foundational structure of the model introduced by PSZ. However, during our analysis, we observed a nuanced feature in their numerical simulations that diverges slightly from the model outlined in their paper. PSZ adopted the utility function framework from Hansen and Imrohoroğlu (1992), yet we identified a subtle discrepancy between their approach and the one presented by Hansen and Imrohoroglu.

While Hansen and Imrohoroğlu (1992) defines the utility function using a standard constant relative risk aversion (CRRA) formulation as follows:

$$u(c_t, l_t) = \frac{(c_t^{1-\sigma} l_t^{\sigma})^{1-\rho} - 1}{1-\rho}, \tag{2}$$

PSZ, in their paper, express a slightly modified function:

$$u(c_t, l_t) = \frac{(c_t^{1-\sigma} l_t^{\sigma})^{1-\rho}}{1-\rho} - 1. \tag{3}$$

We use equation (2) in our simulations. It is crucial to note that the subtraction of 1 in different parts of the function serves as a normalization step and likely does not impact the overarching conclusions drawn in their paper. However, it came to our attention that this normalization step is not consistently applied in their code. Consequently, the simulations in their study consider the following utility function:

$$u(c_t, l_t) = \frac{(c_t^{1-\sigma} l_t^{\sigma})^{1-\rho}}{1-\rho}. \tag{4}$$

Upon a more comprehensive examination of PSZ's work, we identified an additional aspect of their code that warrants consideration. In their model, individuals who accept job offers experience a reduction in leisure time. Specifically, labor is represented as a constant, indivisible amount of time denoted by $\bar{h}$. Consequently, this duration should be subtracted from the total leisure time, which is normalized to 1 in the study, from workers who accept a job offer. However, we observed that this leisure cost of working is not consistently taken into account in their numerical simulations, leading to significant implications for the model's equilibrium.

Remaining consistent with PSZ, we maintain other model parameters. Worker production is standardized to $y = 1$, and we set $\beta = 0.999165$, implying an annual discount of approximately 4% over a year. Additional parameter values include $\sigma = 0.67$, and $\rho = 2.5$. In terms of work, it is assumed that individuals have 98 free hours per week, with an average workweek of 44 hours, accounting for 45% of their time dedicated to work, denoted as $\widehat{h} = 0.45$. The dataset used was sourced from the PSZ paper, providing the α vector for the years 1971 to 2002 in the UK.[2]

[2]The PSZ dataset can be accessed via the following link: https://dataverse.harvard.edu.

4 Computational Strategy

Our computational work is divided into three stages. Firstly, we developed an algorithm to replicate the results of PSZ. Next, we modified the convergence criterion of the value functions in the original algorithm of PSZ. In particular, we use the value of 10^{-5} in our simulations, while PSZ used 10^{-3} in some parts of their algorithm.[3] Finally, we incorporated the leisure cost of working into the algorithm as presented in the previous section.

The computational challenge of this work lies in finding the equilibrium of the models. To achieve this, we discretize individuals' wealth and use a grid ranging from 0 to 20. In the PSZ algorithm, this grid is defined between 0 and 62.5. However, in our simulations, we identified no individuals with wealth above 20 units, leading to our choice of the grid. The step taken in the grid was 0.01. It is important to mention, that we only use 20 as an upper bound when incorporating the the leisure cost of working. In the replication part of our study, we keep the original grid.

For the detailed economy, four possible states are defined for the individual: employed, unemployed in the waiting period to receive UI, unemployed receiving UI, and unemployed receiving other social benefits. These states result from combinations of eligibility (s), job offer (k), and employment decision (x). Thus, an individual cannot be in a situation different from these proposed states. For the simplified economy, there are only two possible states: employed and unemployed receiving UI.

[3] In fact, when computing the equilibrium in the model with the detailed UI program, PSZ used the value of 10^{-4}, but they used 10^{-3} for simulations with the simplified UI program.

There is also a distribution matrix of individuals, where the rows represent the wealth grid, and the columns represent possible states. Thus, we can allocate each person to a wealth and a possible state. The sum of the values in this matrix (the mass of people) must be equal to 1.

For the first iteration, individuals are randomly distributed in this matrix. For this distribution matrix, there exists a τ that will balance the economy. The detailed economy is solved for the given values of α, including θ. The Bellman equation is solved, and we obtain the value function and the policy function from it. Now, with the policy function defined, it is possible to update the distribution matrix of individuals, knowing, for each individual defined by wealth and current state, what wealth they will have in the future, and in which state (through the transition probability matrix). With this updated distribution matrix, a new τ is defined to balance receipts and spending in the UI and other social benefits.

With a new τ, the solution of the Bellman equation changes, as well as the choices of individuals. So a new solution to the Bellman equation is computed. This loop is repeated until the value function and the calculated τ are close enough to the values from the previous iteration, using the convergence criterion mentioned above.

For the simplified economy, the same procedure is used, but with an additional step. The θ previously defined by the vector α is now also a tuning parameter. Therefore, we start with an arbitrary value of θ, and the economy is calculated. The average of the Value function values is then calculated, weighted by the distribution of individuals given by each asset and state. This average is compared to the average of the detailed economy. If the values are not close enough, θ is updated, and the economy's equilibrium is calculated again. These iterations are repeated until the weighted average of the value function for the two economies is close enough. Thus, the θ calculated in the simplified economy is what we call the *Generosity* of the UI program.

5 Results

5.1 Replicating the PSZ main results

The initial phase of our study is dedicated to reproducing the outcomes outlined by PSZ. To achieve this objective, we crafted our algorithm, incorporating the utility function specified in equation (3). Furthermore, we established a constant value for leisure, setting $l_t = 1$ across all potential states of workers. Additionally, we adopted the identical convergence criterion employed by PSZ.

Figure 1 compares our replication of the *Generosity* with the original results from PSZ. Using the same convergence criterion as the original paper, we notice that the initial points converge perfectly, but from 1980 onwards, the results deviate slightly, yet remain close to the original ones. This deviation occurs because, in PSZ's algorithm, the convergence criterion used was not strong enough. Depending on the initial guess of the value function, the algorithm might converge to a different point.

Therefore, although we conclude that the algorithm satisfactorily replicates the results of the paper, we decided to proceed with a second stage in this research: choosing another convergence criterion. Initially, the program considered that it had found the equilibrium of the model when the error between two iterations was 10^{-3}. Now, we set this criterion to 10^{-5}. In this exercise represented by the dark grey line, we observe that the trend of the curve's movement remains the same as the original, but its motion becomes smoother. In addition, most of the points of the new exercises are higher than the original estimated *Generosity*. We also highlight that this more rigorous convergence criteria is later employed in all simulations.

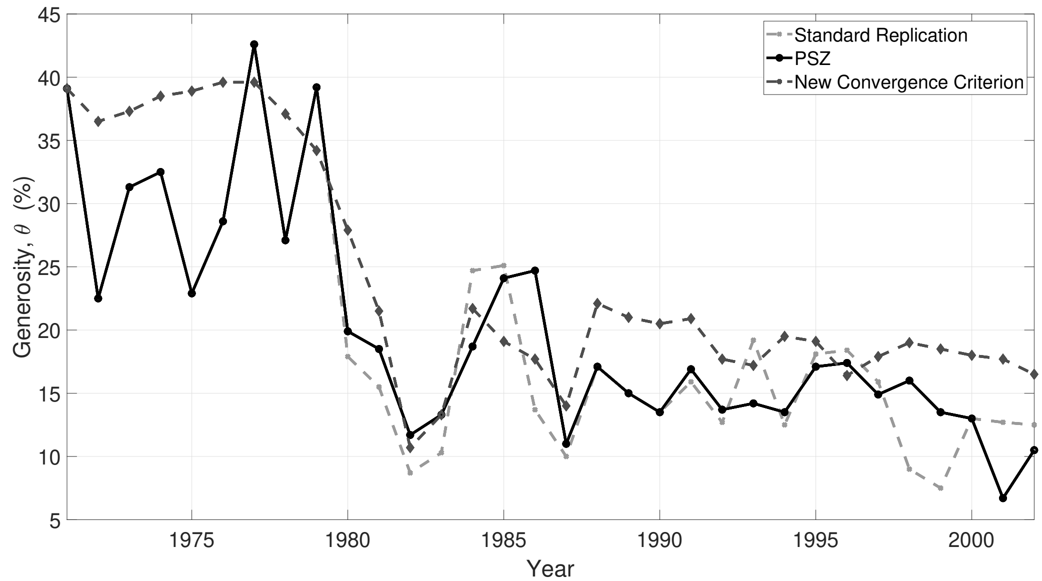


Figure 1: Generosity: Replication *versus* PSZ

Note: The dashed light gray line represents the estimated generosity using the utility function from equation (3), with $l_t = 1$ and a convergence criterion of 10^{-3}. The dashed dark gray line maintains the same conditions but uses a stricter convergence criterion of 10^{-5}. Finally, the black line shows the result obtained by PSZ.

5.2 Reestimating the *Generosity* of the UI program in UK

Next, the leisure cost of accepting a job is implemented in the utility function. Figure 2 replicates in black lines the results presented by PSZ (*Figure 5*), and in grey, the results of our algorithm. In the first 11 years, the graph is plotted with dashed lines to emphasize that for that period we could not find a *Generosity* (θ for the simple model) that would generate the average utility of the detailed model.[4] For all the remaining periods, our algorithm converged.

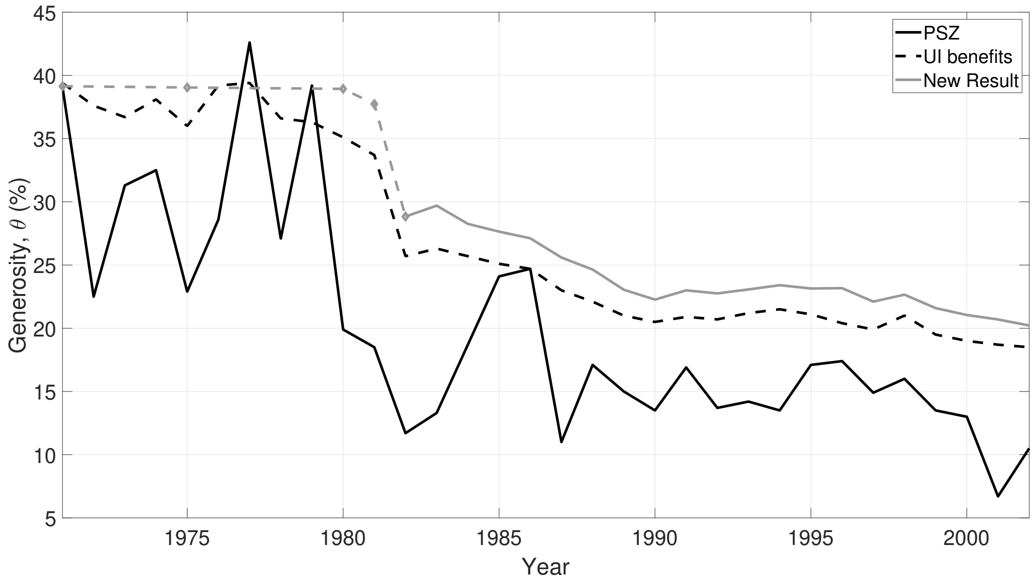


Figure 2: New estimated Generosity *versus* PSZ results

Note: The light gray line represents the estimated generosity considering the costs of leisure, based on the utility function of the equation (3), and a convergence criterion of 10^{-5}. The first 11 years of this estimate are represented in dashed form to indicate that, in this period, our algorithm did not converge. The dashed dark gray line corresponds to the observed generosity data. Finally, the black line illustrates the result obtained by PSZ.

When we include leisure costs, we notice a significant change in the estimated *Generosity*. In PSZ, *Generosity* was below the government's offered benefit, indicating that people accepted less income to streamline the system. Now, however, the estimated *Generosity* is always above the government's benefit line. That indicates that not only the value of the benefit is important, but also that the workers care about other features of the UI program, such as the waiting period, income tests, etc.

[4] Pallage et al. (2013) posited the possibility of such a scenario. In our economic context, we observe that as the level of *Generosity* rises, a decreasing number of individuals accept job offers, necessitating an elevation in the tax rate to maintain equilibrium in the UI program. Upon reaching a specific threshold, job acceptance dwindles further, as a substantial portion of income becomes subject to taxation, eventually resulting in the economic shutdown.

In any case, the outcomes derived from our newly estimated *Generosity* measure align with a decline in this indicator during the 1980s and a subsequent period of stability in the 1990s, mirroring the original findings of PSZ. However, our updated estimation presents a smoother trajectory for *Generosity* over time. Notably, we observe a negative trend persisting throughout the entire period. Consequently, our results support PSZ's assertion that the years under Thatcher and Tony Blair were characterized by a retrenchment in *Generosity*. Nevertheless, our findings diverge from their claim of a positive trend during the John Major years.

5.3 Generosity, taxation, and employment

A crucial aspect of the model is the tax rate, which serves to balance the budget of the UI and other benefits programs. Consequently, we delve into the correlation between taxation and several significant variables in our economy. The subsequent analysis investigates the interplay among *Generosity*, taxation, and employment. It's essential to emphasize that our focus is solely on the years from 1982 onward, as these are the years during which the algorithm converged, producing interpretable results.

Figure 3 compares the tax τ with the UI benefit θ in the detailed model. We observe that the government's tax rate follows the benefit in a leveraged manner. Between 1982 and 1983, θ increases, causing τ to rise as well. After these years, until 1990, θ decreases, leading to a more pronounced decline in τ. This trend continues throughout the period.

In Figure 4, we compare the tax τ with the total number of employed people. These two values draw attention as they respond inversely, almost mirrored; that is, when τ

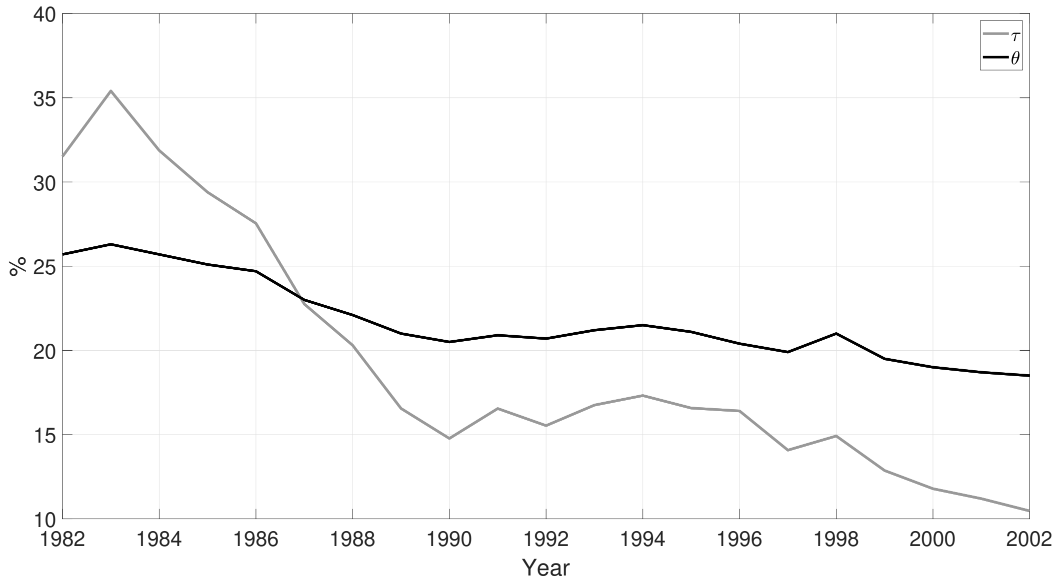


Figure 3: Taxation and Generosity

increases, the number of workers decreases almost in the same proportion. The black line represents the absolute average between the values of τ and the number of employees, clearly illustrating the mirrored functions, with the average forming an almost straight line centered between them.

The combination of Figures 3 and 4 provides an understanding of why the model becomes unstable between the years 1971 and 1981. During these years, the government's benefits were high. With such high values, the tax τ tends to be even higher, resulting in two effects: people will be encouraged to be unemployed and receive social benefits, and people will be discouraged from working since they will receive less for it (given the high tax). Thus, unemployment increases, reaching levels that make the economy unsustainable.

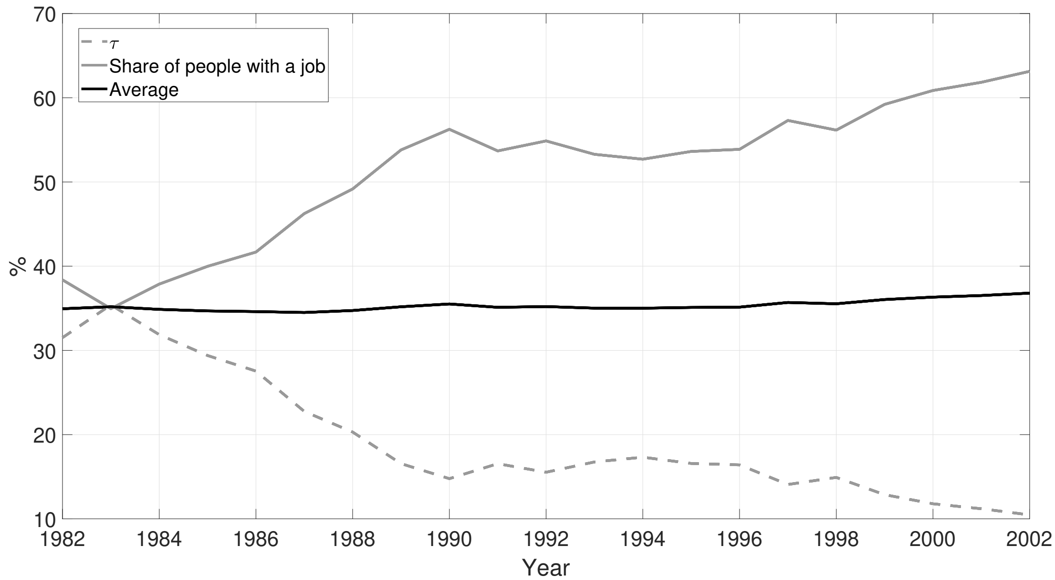


Figure 4: Taxation and employment

5.4 Features of the models with and without leisure cost of working

In this section, we draw comparisons regarding the characteristics of the economy computed throughout the study. The subsequent figures present a juxtaposition between detailed and simplified models, encompassing both new results (involving the leisure cost of working) and PSZ results. Since the data analyzed in this section is not available in PSZ's study, we use the values computed by our algorithm when replicating their work keeping their convergence criterion.

Figure 5 illustrates the impact of government taxation, τ, on individuals' income within the model. Notably, in the absence of considerations for the leisure cost of working, taxation levels are significantly lower compared to scenarios where this factor is integrated. This disparity arises because, in the absence of leisure costs, workers have a greater incentive to accept job offers, as there is no associated cost, only the allure of increased income. Conversely, when a reduction in leisure accompanies the acceptance of job offers, wealthier workers may opt to reject offers, thereby diminishing the taxable base of the economy. Consequently, a higher tax rate becomes necessary to maintain equilibrium in the budget of the UI program (and other associated benefits, in the case of the detailed model).

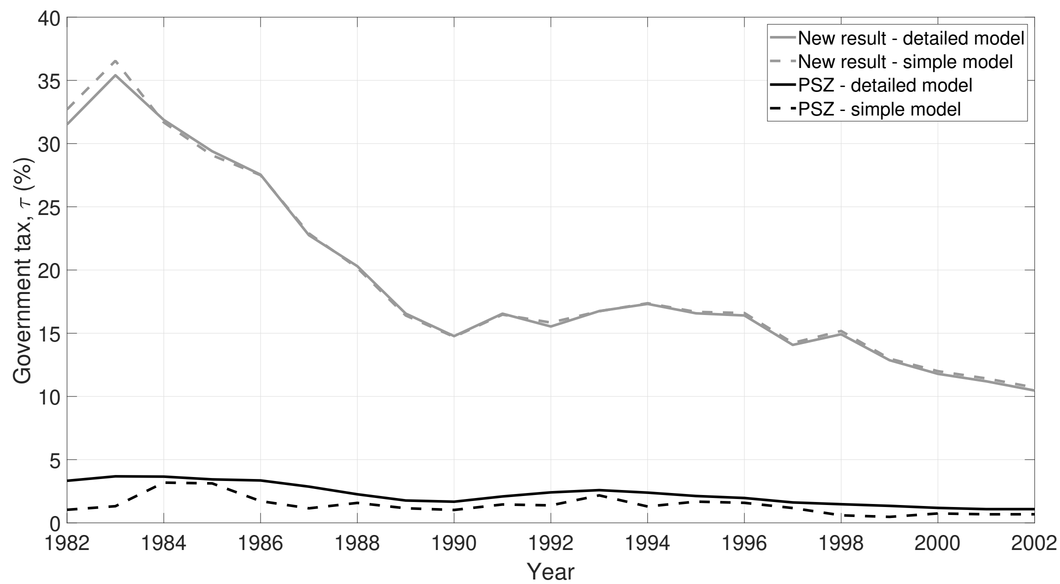
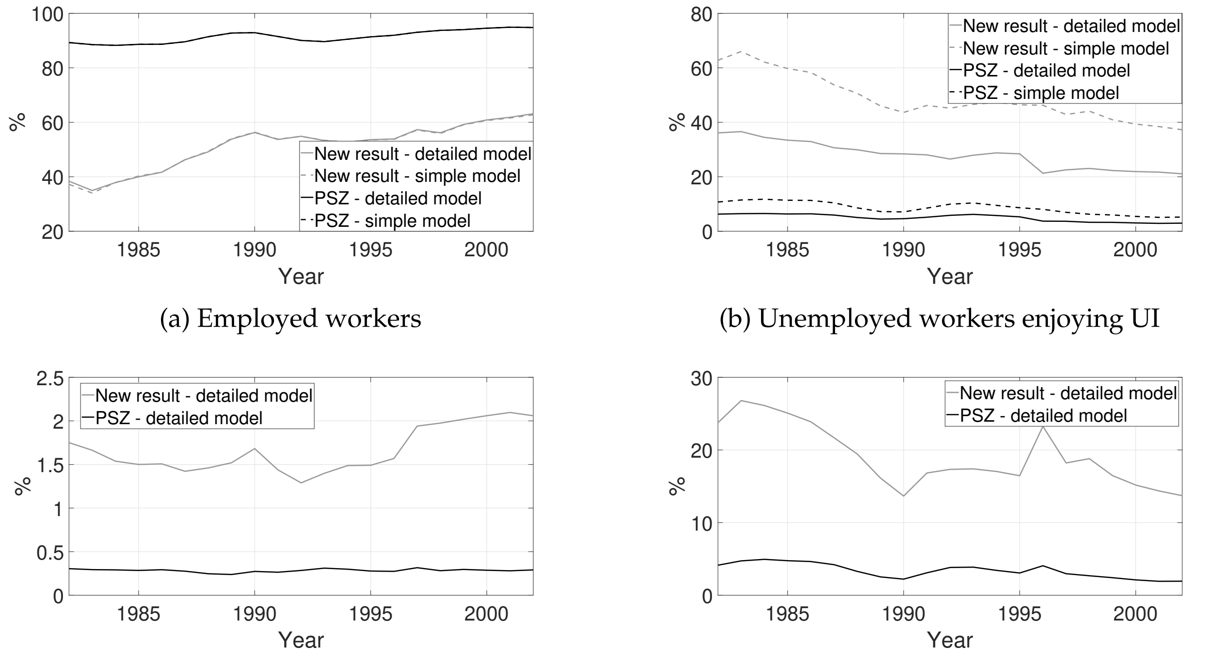


Figure 5: Government Taxation, τ

In Figure 6, we present the distribution of individuals across the four states of the model. Figure 6a illustrates that the economy exhibits a higher rate of employment in the model without considering leisure costs compared to our revised version, as anticipated. On the other hand, Figure 6b indicates a larger proportion of individuals benefiting from the UI in the model that accounts for the leisure cost of working.

Moreover, Figure 6b underscores a more frequent utilization of the UI by individuals in the simplified model. This aligns with the concept that individuals necessitate a higher threshold, θ, to be indifferent from the detailed model to a simplified one in terms of



(a) Employed workers

(b) Unemployed workers enjoying UI

(c) Unemployed workers waiting for UI

(d) Unemployed workers receiving other benefits

Figure 6: Share of workers in each possible state

average expected utility. As a higher θ leads individuals to turn down more job offers, it is logical to observe a heightened proportion of individuals benefiting from the UI in the simplified model compared to the detailed counterpart.

However, it is worth noting that, in the new results, the unemployment rate appears unreasonably high. Despite this, across all simulations, a consistent negative trend in the unemployment rate is evident throughout the analyzed period. This aligns with the decline in the unemployment rate during the 1980s but contrasts with the inverted-U shape observed in the rate during the 1990s.

Figures 6c and 6d further confirm this trend, demonstrating an increased number of individuals awaiting UI benefits and a higher count of unemployed individuals receiving other social benefits in the model that considers leisure costs.

Figure 7 highlights a notable aspect of our novel findings. In contrast to the PSZ replication where no worker turns down a job offer, our results reveal instances where workers reject such offers, particularly when factoring in the leisure cost. This phenomenon can be attributed to the comparison workers make between receiving UI and opting for a higher income, albeit at the expense of reduced leisure time.

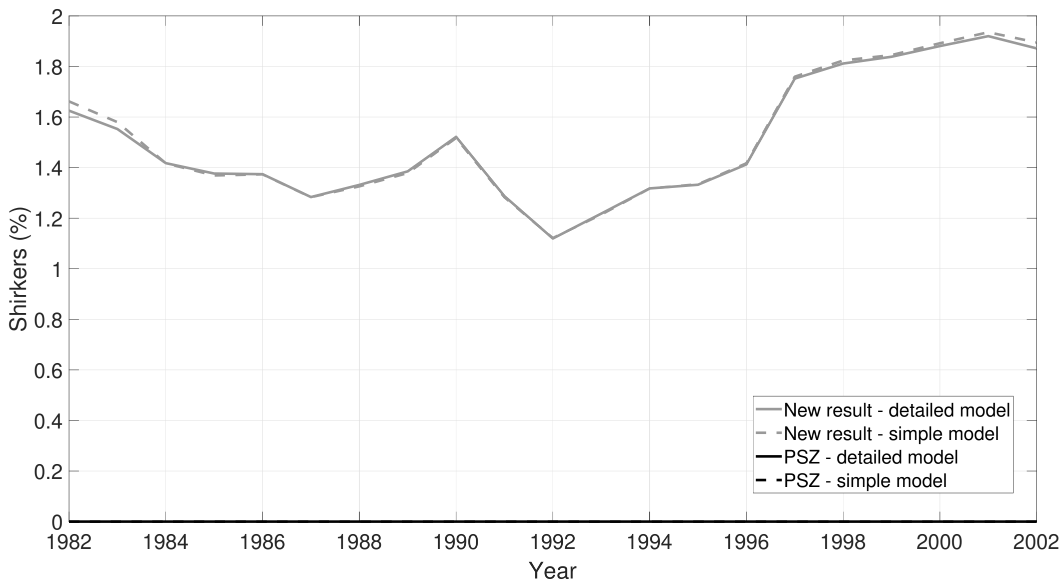


Figure 7: Share of people rejecting job offers

6 Final Remarks

In conclusion, Pallage et al. (2013) have made a noteworthy contribution by establishing a comprehensive model for assessing the generosity of unemployment insurance programs. Despite some shortcomings in their numerical simulations, which we have meticulously addressed in this study, their work lays a solid foundation for understanding the dynamics of these programs. PSZ's model provides valuable insights into the impact of various program features on economic outcomes, setting the stage for further exploration and refinement.

Building upon the groundwork laid by PSZ, our study introduces refinements to their implementation, addressing subtle nuances in their numerical simulations. By delving into the utility function normalization and incorporating the leisure cost of working, we aim to enhance the accuracy and applicability of the model. While recognizing the importance of PSZ's initial contribution, our work represents a valuable addition, refining the results and contributing to the ongoing discourse on the complexities of unemployment insurance programs.

References

Abraham, M., K. Auspurg, S. Bähr, C. Frodermann, S. Gundert, and T. Hinz (2013). Unemployment and willingness to accept job offers: results of a factorial survey experiment. *Journal for Labour Market Research 46*(4), 283–305.

Bellman, R. (1954). The theory of dynamic programming. *Bulletin of the American Mathematical Society 60*(6), 503–515.

Boone, C., A. Dube, L. Goodman, and E. Kaplan (2021, May). Unemployment insurance generosity and aggregate employment. *American Economic Journal: Economic Policy 13*(2), 58–99.

Guo, A. (2024). Payroll tax incidence: Evidence from unemployment insurance. *Journal of Public Economics 239*, 105209.

Hall, A. and G. Zoega (2020). Welfare, leisure and unemployment. *Economics Letters 193*, 109277.

Hansen, G. D. and A. Imrohoroğlu (1992). The role of unemployment insurance in an economy with liquidity constraints and moral hazard. *Journal of Political Economy 100*(1), 118–142.

Johnston, A. C. (2021). Unemployment insurance taxes and labor demand: Quasi-experimental evidence from administrative data. *American Economic Journal: Economic Policy 13*(1), 266–293.

Pallage, S., L. Scruggs, and C. Zimmermann (2013). Measuring unemployment insurance generosity. *Political Analysis 21*, 524–549.

Schmieder, J. F. and T. Von Wachter (2016). The effects of unemployment insurance benefits: New evidence and interpretation. *Annual Review of Economics 8*(1), 547–581.

Siddique, A. B. (2023). Job market polarization and american poverty. *Journal for Labour Market Research 57*(1), 30.

Stijepic, D. (2021). A cross-country study of skills and unemployment flows. *Journal for Labour Market Research 55*(1), 9.