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How to Fund Unemployment Insurance with Informality and False Claims: Evidence from Senegal

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Abstract

This paper studies the welfare effects of unemployment insurance (UI) in low-income countries characterized by high levels of informality, weak enforcement of UI claims, and job search frictions. We assess the impact of UI on workers' welfare in the presence of moral hazard and liquidity constraints. Our analysis highlights the significance of the UI scheme design on workers' welfare and identifies potential funding constraints in implementing UI in imperfect labor markets. Using a custom labor force survey conducted in Senegal, we estimate the key parameters of an extended Chetty (2006) model incorporating an informal sector, and we evaluate the welfare implications of three different UI schemes with varying degrees of enforcement and funding sources. Our results demonstrate that workers respond to UI benefits and that welfare gains depend on the design of the UI system. We find that broad-based taxation through a VAT, inflation tax, or external funding can compensate for weak enforcement (i.e., high false UI claim rates), leading to substantial and quantifiable welfare gains. Moreover, safety net expansions reduce loan default rates, potentially fostering greater credit access. This study emphasizes the need to increase the prevalence of UI in low-income countries and provides insights into the design of achievable UI schemes that deliver significant welfare improvements.

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1 Introduction

Unemployment insurance (UI) serves as a crucial social program for workers in high-income countries. Labor markets in these countries typically exhibit high levels of formality, and employment spells and wages can be tracked with relative ease through labor force surveys and employer-employee-matched data. These characteristics contribute to the effective functioning and comprehensive coverage of UI programs for most workers in high-income countries (Vodopivec, 2009).

The prevalence of UI is considerably lower in low-income countries compared to high-income ones. This disparity can be attributed to difficulties in tracking work statuses and wages of the workforce, funding the UI budget, and overcoming the political and socioeconomic obstacles associated with the implementation of UI (Cirelli et al., 2021; Benjamin and Mbaye, 2012). Nevertheless, policymakers and donors increasingly recognize the importance of introducing, strengthening, and enhancing worker protection (Duval and Loungani, 2019). Long considered secondary to job provision, worker protection is now garnering attention due to the high dependency of unemployed individuals on private transfers from wage earners (Cox et al.,(1998), Cox and Fafchamps, (2007), among others). In low-income African countries, wage earners frequently serve as the financial backbone for a broad network of economic agents, providing insurance for their kin and peers against shocks, facilitating transfers to extended family, and fostering economic relief.

Despite the growing acknowledgment of the potential benefits of UI in low-income countries, enthusiasm for UI as a macroprudential policy tool often wanes when confronted with two significant questions related to its implementation: How can UI be funded in a context where taxpayers constitute only a small fraction of the workforce, and the social planner faces financial constraints? How should UI accommodate informal workers, who make up the vast majority of the labor force?

This paper advances our understanding of the impact and optimal design of UI in contexts characterized by high levels of informality, weak enforcement, and job search frictions. To this end, we address the following questions: (i) What potential welfare gains can be achieved if informality were not present? (ii) To what extent is a standard labor-tax-funded UI system[1] limited under weak enforcement? (iii) Can broad-based UI funding through a VAT, inflation tax, or external funding result in substantial welfare gains?

To address these questions, we extend the Chetty (2006) model by allowing informal

[1]These are the typical contributory UI systems found in high-income countries and the OECD

workers to collect UI benefits while working and by distinguishing work status among informality, formality, and unemployment. Subsequently, we derive a closed-form solution for the optimal level of benefits. Importantly, our theory emphasizes that in the presence of informal work and limited enforcement of eligibility criteria, funding constraints for standard labor-tax-funded UI systems can be significantly binding. In that regard, our work is most closely related to Cirelli et al. (2021) who examine individual savings accounts funded by labor taxes in middle-income countries with informality. However, we depart from Cirelli et al. (2021) in two significant ways. First, we consider broad-based taxation such as consumption taxes (value-added taxes) to address the binding funding constraint faced by social planners in this context. Second, we incorporate varying degrees of UI false claim rates due to a potential variation in the ability of the social planner to observe informal work.

We identify the essential parameters required to quantify the associated welfare changes. These key parameters include: (i) job search elasticities for each work state with respect to the benefit level, (ii) consumption values, (iii) workers' risk aversion, and (iv) the degree of informal work and limited enforcement. After estimating these parameters, we assess the relative strength of moral hazard versus liquidity and provide welfare estimates for the value of UI.

To estimate the model, we conducted a labor force survey in Senegal, a country whose labor market characteristics are similar to those found in other low-income African countries. Our survey is specifically designed to inform the key parameters identified in the conceptual framework. We then estimate the marginal welfare gain of UI benefits in labor markets, considering the presence of moral hazard and liquidity constraints. We do so for three different schemes with varying degrees of enforcement and funding sources: (i) an environment of perfect enforcement of employment status, where the government can fully impose UI contributions on formal workers and there are no false claims from informal workers, (ii) a standard labor-tax-funded UI system with limited enforcement, where only formal workers contribute, but both unemployed individuals and informal workers benefit, and (iii) an environment with limited enforcement, where the benefits are funded externally and provided to unemployed individuals and where a portion of workers in the informal sector can submit false claims.

We have three main results. Our first result is that with zero informality and zero false UI claims, a standard labor tax-funded UI program yields significant welfare gains. A 1% labor tax put toward UI yields a 1.4% consumption-equivalent welfare gain. This is a good description of high-income countries, but not low-income African countries where the majority of workers are in the informal sector. Our second result is that, with high levels of informality and UI false claims, a standard labor-tax-funded UI program yields much lower

welfare gain. A 1% labor tax put toward UI yields a 0.28% consumption-equivalent welfare gain in the Senegalese context we study.

Our third and most important result is that UI funded by a consumption tax (or value-added tax (VAT)) performs significantly better under high levels of informality and false claim rates than a standard labor-tax-funded UI program. We find that a 1% consumption tax put toward UI yields consumption-equivalent welfare gains of 0.33%. While the consumption tax of 1% raises a different level of revenue than a labor tax of 1%, when we compare revenue-equivalent schemes, the VAT-funded scheme yields higher welfare gains than the labor tax-funded scheme for false claims rates above roughly 50%. The intuition is that when the rate of false claims is high, the consumption tax allows for a better redistribution of the resources gathered, leading to an improvement over the labor-tax-funded UI program. In particular, when the rate of false claims is sufficiently low, such as in economies with highly formalized labor markets, we recover the standard result that a VAT is regressive if its incidence falls on consumers. Our results are robust to different levels of tax evasion, informal transfers, and risk aversion of workers.

We also use our survey to assess the effect of safety nets on credit constraints and defaults. Our survey provides suggestive evidence that expanding the safety net would reduce loan defaults. That safety net expansions reduce loan default rates supports the view that safety nets and credit access are complementary (e.g. Braxton et al. (2020) and Bornstein and Indarte (2022)). Our results suggest that a VAT-funded safety net expansion "kills two birds with one stone" by (1) improving insurance and welfare while (2) potentially fostering greater credit access.

Collectively, our results emphasize the need to increase the prevalence of UI in low-income countries, draw attention to the trade-offs inherent in UI schemes in such imperfect labor markets, and suggest achievable UI schemes with substantial and quantifiable welfare gains.

1.1 Literature Review

The empirical literature reveals several distinct patterns in the labor markets of low-income countries. They typically exhibit: (i) high levels of informality and self-employment, (ii) substantial worker transition rates between formal and informal sectors and between agricultural, manufacturing, and service sectors (Breza et al., 2021; Donovan et al., 2021), and (iii) labor market frictions arising from skill mismatches, job searches, job productivity, and migration barriers between economic sectors (Alfonsi et al., 2020; Behrman, 1999; Bryan et al., 2014; Hamory et al., 2020).

Some structural and semi-structural models do welfare evaluations of UI in middle-income

and low-income countries without enforceability constraints. Bosch and Esteban-Pretel (2015) examines the implementation of a UI scheme in an environment with high informality using a search and matching model calibrated on Mexican data. The study concludes that the design and execution of the UI scheme significantly influence the effectiveness of the policy. On the contrary, Gerard and Gonzaga (2021) studies the Brazilian context and finds that in countries with high informality, the efficiency cost of UI benefits may not be higher than in more formalized economies, as reemployment rates in the formal sector remain low regardless of the policy. Similarly, Margolis et al. (2015) estimates low degrees of efficiency losses in the presence of informal work, albeit assuming very high levels of policy enforceability. In the Mauritian context, Liepmann and Pignatti (2021) finds that welfare effects of UI generosity are positive and comparatively large even when informality is high. Gonzalez-Rozada and Ruffo (2016) qualify that Argentinian data that if a developing country with high informality introduces a new UI system, a short UI duration should be considered. Our paper differs from these works in emphasizing the funding constraints associated with weak enforceability (false claims) and, therefore, the need for broad-based taxation to reap insurance gains from UI.

Therefore, this paper contributes to the limited literature on empirical evidence of welfare gains from UI in low-income countries and feasible policies to achieve them when enforcement is weak. The scarcity of empirical evidence is partly due to the relatively few cases of UI adoption in low-income countries and the lack of high-frequency labor force surveys in these countries. Our study, using a combination of a custom survey and a national labor force survey, is among the first ones to quantify the welfare gains of UI for low-income African economies while accounting for the characteristics of the labor market that pose significant challenges to the implementation of UI schemes in this context. In doing so, we emphasize the relative merits and efficiency of various scheme designs. We consider the conclusions of this study to be representative of labor markets in low-income economies and its contribution substantial, as there is little empirical evidence on the optimal approaches for implementing UI in contexts with labor market frictions.

Outline: The remainder of this paper is organized as follows. Section 2 presents the theoretical framework and identifies the key sufficient statistics required to estimate welfare gains from different UI policies. Section 3 introduces the data and discusses the descriptive statistics. Section 4 provides the results of our welfare analysis and elaborates on their implications. Section 5 presents the robustness of our results to different levels of tax evasion, informal transfers, and risk aversion of workers. We also extend our results to credit constraints and defaults. Finally, Section 6 offers concluding remarks.

2 Conceptual Frameworks

In this section, we analyze the welfare implications of unemployment insurance by extending the Chetty (2006) model to incorporate an informal sector. The first economy assumes that UI is funded by distortionary wage taxes and that there is UI fraud (or false claims) due to unobservable informal work. We compare this first welfare analysis to a second economy model without an informal sector and with zero false claims. Lastly, we consider a third economy in which the UI policy is financed by a VAT in the presence of informality and false claims.

2.1 Model I: UI Funded by Wage Taxes with Informality and False Claims

We consider a static model in which workers can be formally employed (f), informally employed (i), or unemployed (u). Their utility denoted $u(\cdot)$, is assumed to be concave and increases in disposable income, consisting of their wages (w), assets (A), and government transfers. Workers search for jobs in both formal and informal job markets, incurring a utility cost of $\psi(s^f)$ and $\psi(s^b)$, respectively. The formal and informal wages are represented by w^f and w^i, respectively. Formal workers contribute to the UI system through a payroll tax (τ), while the unemployed and a share λ of informal workers receive unemployment benefits equal to a share b of formal income or bw^f. Thus λ is the *false-claim rate*, also referred to as the UI fraud rate. The probability of finding a job is s^f in the formal sector, and s^i in the informal sector, with the expected resulting welfare of a worker indicated as W. Specifically, we focus on a policy in which UI benefits replace a fraction b of consumption in the formal sector. This formulation allows us to determine the appropriate percentage replacement rate for the UI system. Workers consider the UI replacement rate b as a given constant in their optimization problem. Therefore, they solve the following problem:

$$\max_{s^f,s^i} W(s^f,s^i) = \max_{s^f,s^i} V(s^f,s^i) - C(s^f,s^i) \tag{1}$$

$$V(s^f,s^i) = s^f V^f + s^i \lambda V^{i,\lambda} + s^i(1-\lambda)V^{i,1-\lambda} + (1-s^f-s^i)V^u$$

$$V^f = u(A + w^f - \tau) \quad \text{(Value of formal work)}$$

$$V^{i,\lambda} = u(A + w^i + bw^f) \quad \text{(Value of informal work with UI)}$$

$$V^{i,1-\lambda} = u(A + w^i) \quad \text{(Value of informal work without UI)}$$

$$V^u = u(A + bw^f) \quad \text{(Value of unemployment)}$$

$$C(s^f,s^i) = \psi(s^f) - \psi(s^i) \quad \text{(Cost of search)}$$

The search policy functions $s^f(b)$ and $s^i(b)$ depend on the UI replacement rate b, whereby both functions decrease in the benefit level. Consequently, unemployment insurance gives rise to moral hazard.

The social planner takes into account the moral hazard arising from households' search behavior and the resulting fiscal externalities. We assume that the social planner chooses the level of benefits b that maximizes welfare W subject to the government's balanced budget constraint. The budget balance condition requires that the taxes collected from the formal sector fund the benefits provided to both unemployed and informal workers. Mathematically, the planner's problem can be expressed as follows.

$$\max_b W(s^f(b), s^i(b)) \tag{2}$$

subject to

$$s^f(b)\tau = (1 - s^f(b) - (1-\lambda)s^i(b))bw^f$$

2.1.1 Moral Hazard and Liquidity Effects

To simplify the analysis, we introduce the definitions of formal, informal, and unemployed consumption as follows: $C^f = A + w^f - \tau$, $C^i = A + w^i + bw^f$, and $C^u = A + bw^f$. By applying the envelope theorem to the workers' search choice, we derive the following first-order condition:

$$\frac{\partial W}{\partial b} = -s^f u'(C^f)\frac{\partial \tau}{\partial b} + [\lambda s^i u'(C^i) + (1 - s^i - s^f)u'(C^u)]w^f, \tag{3}$$

where the term ψ' disappears due to the equal marginal search costs and marginal utility values.

The impact of additional unemployment insurance (UI) on the required tax can be expressed as:

$$\frac{\partial \tau}{\partial b} = w^f \frac{1 - s^f - (1-\lambda)s^i}{s^f} - bw^f \frac{1}{(s^f)^2}\frac{\partial s^f}{\partial b} - bw^f \frac{1}{(s^f)^2}\frac{\partial s^i}{\partial b}, \tag{4}$$

where the first term represents the direct effect of an increased cost of the social program, and the second term reflects the indirect effect resulting from workers transitioning from formal employment to other states in response to the tax.

By combining equations (3) and (4), we derive the following expression:

$$\begin{aligned}\frac{\partial W}{\partial b} = &\underbrace{w^f \left[\lambda s^i u'(C^i) + (1-s^i)u'(C^u) - (1-s^f)u'(C^f) + (1-\lambda)s^i u'(C^f)\right]}_{\text{liquidity effect}} + \\ &\underbrace{w^f u'(C^f)\left(\varepsilon_{s^f,b} + (1-\lambda)\frac{b}{s^f}\frac{\partial s^i}{\partial b}\right)}_{\text{moral hazard effect}},\end{aligned} \tag{5}$$

where $\varepsilon_{s^f,b}$ represents the elasticity of formal employment with respect to the benefit (i.e., $\varepsilon_{s^f,b} = \frac{\partial \ln s^f}{\partial \ln b}$). Unemployment insurance has two opposing effects on total welfare. On one hand, social benefits redistribute consumption from wealthier to poorer agents, thereby improving welfare through a liquidity channel. On the other hand, the tax levied to finance the UI program reduces the attractiveness of formal employment, leading formal workers to transition to informal jobs or unemployment, ultimately diminishing overall wealth and welfare.

To assess the welfare effects of changes in benefits, we calculate the marginal difference in household welfare while maintaining a constant search effort. Given the low unemployment elasticities with respect to benefits observed in Senegal, this approximation is justifiable (see Section 4). Accordingly, we compute the consumption-equivalent welfare effects (denoted x) by plugging the value of $\frac{\partial W}{\partial b}$ recovered from equation (5) into the left-hand-side of equation (6) and then solving for x:

$$\frac{\partial W}{\partial b}\Delta b = \frac{1}{1-\sigma}\Big((1-s^f-s^i)\big((x\cdot c_u)^{1-\sigma} - c_u^{1-\sigma}\big) + s^f\big((x\cdot c_f)^{1-\sigma} - c_f^{1-\sigma}\big) + s^i\big((x\cdot c_i)^{1-\sigma} - c_i^{1-\sigma}\big)\Big) \tag{6}$$

To estimate the welfare implications of expanding unemployment insurance (UI), it is necessary to identify the following parameters: (i) C^f, C^i, and C^u: consumption expenditures for formally employed, informally employed, and unemployed individuals, respectively; (ii) $u'(\cdot)$: the marginal utility function of households, which captures their risk aversion; (iii) s_0: the initial job finding rate; and (iv) $\varepsilon_{f,b}$: the elasticity of the formal employment rate with

respect to benefits, encompassing both the extensive and intensive margins.

Before conducting an analysis, it is unclear which channel, liquidity constraints or moral hazard, plays a more prominent role in influencing the impact of UI benefits on job search, particularly in a context with high informality. In terms of the liquidity channel, our model highlights an additional effect that arises from providing consumption for informal workers, represented by $s^i u'(C^i)$.

Regarding the moral hazard channel, we observe the following comparative statics. First, as the level of benefits increases, the individual's desire for formal work decreases, leading to a decreasing function $s^f(b)$. Additionally, it is reasonable to assume that higher benefit levels correspond to a higher likelihood of unemployment, resulting in a decreasing function $s^f(b) + s^i(b)$. To account for the substitutability between formality and informality, we incorporate an additive cost of search $\psi(s^f(b)) + \psi(s^i(b))$ for both formal and informal work. This captures the hybrid nature of informality, which exhibits characteristics of both formal employment (such as income and labor effort) and unemployment (as individuals eligible for UI benefits can pretend to be unemployed and claim those benefits).[2]

Before moving to the empirical analysis, we examine two specific cases. First, we consider a scenario in which the government possesses perfect information regarding the worker's employment status. This transforms the model into an equivalent one to that of Chetty (2006), establishing an upper bound for the effects of UI. Second, we consider a case in which the UI scheme is financed through a broad-based tax, such as a value-added tax (VAT). This reduces the moral-hazard effect and simplifies the implementation of the policy.

2.2 Model II: UI Funded by Wage Taxes with Zero Informality and Zero False Claims

In this section, we focus on an economy without an informal sector and without false claims. In this setting, the government has the ability to accurately determine the employment status of individuals, distinguishing between those who are employed and those who are unemployed. Consequently, UI is funded by all employed workers, and benefits are exclusively provided to the unemployed. The model in this scenario represents a special case of the one presented in subsection 2.1. By examining this benchmark, we establish an upper bound for the potential welfare gains achievable through social insurance without informality.

[2]Indeed when w^i/w^f is sufficiently low, individuals are motivated to search more for formal jobs, while when w^i/w^f is sufficiently high, they are incentivized to search more for high-earning informal work in order to avoid paying taxes.

In this scenario, workers solve the problem:

$$\max_s W(s) = \max_s \underbrace{su(w + A - \tau)}_{\text{Value of employment}} + \underbrace{(1-s)u(bw + A)}_{\text{Value of unemployment}} - \underbrace{\psi(s)}_{\text{Cost of search}} \tag{7}$$

where $W(s)$ represents the overall welfare associated with a given search policy function s, which is dependent on the replacement rate.

Meanwhile, the social planner selects the benefit level b that maximizes welfare W according to the objective:

$$\max_b W(s(b)) \tag{8}$$

subject to the budget balance constraint:

$$s(b)\tau = bw[1 - s(b)].$$

We can then repeat the derivation presented in Section 2.1.1 to obtain the following relation:

$$\frac{\frac{\partial W}{\partial b}}{\left[u'\left(C^e\right)s(b)\right]}\frac{1}{w} = \frac{(1-s(b))}{s(b)}\left[\frac{\left[u'\left(C^u\right) - u'\left(C^e\right)\right]}{u'\left(C^e\right)} - \frac{1}{s(b)}\underbrace{\frac{b}{(1-s(b))}(-1)\frac{\partial s(b)}{\partial b}}_{e_{1-s,b}}\right] \tag{9}$$

As described in the prior section, we assess welfare under the assumption that search effort is constant. We justify this by the extremely low empirical estimates for unemployment elasticities in Senegal (see Section 4). Consequently, this process leads to the following expression for the welfare effects of a policy under our CRRA utility function, with σ representing relative risk aversion:

$$\frac{\partial W}{\partial b}\Delta b = \frac{1-s_0}{1-\sigma}((x \cdot c_u)^{1-\sigma} - c_u^{1-\sigma}) + \frac{s_0}{1-\sigma}((x \cdot c_e)^{1-\sigma} - c_e^{1-\sigma}). \tag{10}$$

In this expression, we compare the welfare shift computed from equation (9) to the analogous change in welfare that would ensue if every individual, regardless of their employment status, received an income increment of x under the condition that their employment ratios remain unaltered. This approach enables us to derive the value of x, which represents the aggregate consumption equivalent of a boost in unemployment benefits and hence serves as our welfare metric. To calculate standard errors, we conduct a Monte Carlo simulation in which we sample 60% of the total population and replicate the computation for a total of 10,000 iterations.

2.3 Model III: UI Funded by VAT with Informality and False Claims

In the model featuring limited enforcement, we examine a scenario in which the unemployment insurance (UI) scheme is financed through a consumption tax or a value-added tax (VAT), thereby mitigating the prevalence of moral hazard. We assume that UI benefits are provided to all unemployed individuals and a fraction (1-λ) of informal workers. Consequently, higher values of λ indicate stricter enforcement of UI eligibility criteria.

In this scenario, workers aim to solve the following problem:

$$\begin{aligned}\max_{s^f,s^i} W(s^f,s^i) = \; & \max_{s^f,s^i} \underbrace{s^f u\left((1-\tau)C^f\right)}_{\text{Value of formal work}} \\ & + \underbrace{s^i\left[\lambda u\left((1-\tau)(C^i+bC^f)\right)+(1-\lambda)u\left((1-\tau)C^i\right)\right]}_{\text{Value of informal work}} \\ & + \underbrace{\left(1-s^i-s^f\right)u\left((1-\tau)C^u+bC^f\right)}_{\text{Value of unemployment}} - \underbrace{\psi(s^f)-\psi(s^i)}_{\text{Cost of search}}\end{aligned} \tag{11}$$

which leads to the determination of the policy functions $s^f(b)$ and $s^i(b)$.

The social planner chooses the level of benefits b that maximizes welfare W as follows:

$$\max_b W(s^f(b), s^i(b)) \tag{12}$$

subject to the budget constraint budget constraint that ensures the resources collected from the value-added tax (VAT) are sufficient to cover the additional consumption of the beneficiaries of the unemployment insurance (UI) system:

$$s^f(b)C^f\tau+s^i(b)\Big[\lambda\tau(C^i+bC^f)(1-\lambda)\tau C^i\Big]+(1-s^f(b)-s^i(b))\tau(C^u+bC^f) = bC^f\big(1-s^f(b)-(1-\lambda)s^i(b)\big) \tag{13}$$

In Appendix B3, we provide a thorough analysis of the effects of a change in benefits on the government's budget constraint (13). In sum, the impact of a marginal increase in the level of benefits can be understood in three ways. First, there is a direct effect resulting from the additional expenses associated with increased benefits, which in turn raises the required tax revenue. Second, as the consumption of certain individuals rises, the VAT revenue generated from their consumption also increases. Third, the movement of some formal workers to the informal sector and unemployment reduces the taxable base, necessitating an increase in the VAT rate.

With these insights, we can quantify the overall welfare changes resulting from adjustments in the UI benefit level, following a methodology similar to those presented in subsec-

tions 2.1 and 2.2.

3 Data

The survey conducted for our empirical analysis aims to provide a representative sample of the urban population in Senegal. This approach aligns with the common practice in labor force surveys conducted in low-income countries, which primarily focus on urban areas.[3] Thus, we abstract from the spillover effects of labor market policies on rural migration emphasized by Harris and Todaro (1970). Furthermore, rural areas, where agricultural workers are typically found in Senegal, have dedicated government programs, such as agricultural input subsidies, which could mitigate any potential effect of UI on rural-urban migration.

The survey design follows a stratified random sampling approach. First, we define the population of the study as all active workers in Dakar. Second, we utilize primary sampling units (PSUs) known as enumeration areas (EAs), as defined by the national statistical agency during the 2013 population census. These EAs are distributed across the five districts in the Dakar region (Dakar, Guediawaye, Keur Massar, Pikine, and Rufisque). We randomly select 23 EAs from the set of 129 EAs in Dakar. Third, within each selected EA, we randomly sample a fixed number of households. The survey covers all individuals aged 15 and over within selected households. In total, we surveyed 1314 individuals across 345 households. To ensure the sample's representativeness, we apply weights to the data using information from the population census. Appendix D provides detailed information on the context of the study.

Table 1 provides a comparative analysis of key demographic variables, employment, and job search characteristics for two groups: the sample of respondents from our survey (columns 2-5) and the respondents from the nationally representative labor force surveys conducted by the Senegalese Statistical Agency.[4] The sample displays a relatively balanced distribution across demographic variables and job search indicators. However, some disparities arise with regard to formality level and salary, which can be attributed to the study's specific focus on urban areas. These variations will be further explored and assessed for robustness in Section 5.

The survey encompasses both employment and non-employment experiences encountered by the respondents in our sample. Specifically, the survey includes a range of modules covering various aspects, including:

[3]Given the context and cost considerations, it would be prohibitively expensive to create a labor force survey that encompasses both urban and rural workers.

[4]For a comprehensive understanding of the Senegalese labor market and further details on the nationally representative labor force surveys used for comparison, please see Section D in the Appendix.

Table 1: Side-by-Side Summary Statistics - Custom Survey vs. Labor Force Survey

Data Source:	**Own Survey**			**Labor Force Surveys**		
Statistic:	**Mean**	**SD**	**Obs.**	**Mean**	**SD**	**Obs.**
General						
Is male	0.48	0.5	1314	0.44	0.50	132230
Is household head	0.24	0.43	1314	0.21	0.41	132230
Age						
Age is less than 25 yrs (0/1)	0.3	0.46	1373	–	–	–
Age is 25-34 yrs (0/1)	0.25	0.43	1373	0.28	0.48	132230
Age is 35-44 yrs (0/1)	0.16	0.37	1373	0.16	0.50	132230
Age is 45-54 yrs (0/1)	0.13	0.33	1373	0.12	0.45	132230
Age is 55+ yrs (0/1)	0.17	0.38	1373	0.16	0.37	132230
Employment Status						
Has a paid job (0/1)	0.47	0.5	1314	0.39	0.49	132230
No paid job (0/1)	0.53	0.5	1314	0.61	–	132230
Employment is formal (0/1)	0.2	0.4	617	0.09	0.28	60756
Employment is informal (0/1)	0.8	0.4	617	0.91	0.28	60756
Reported salary (000s XOF)	117.13	118.47	1314	74.53	117.84	18633
Job Search						
Has searched for a job in past week (0/1)	0.06	0.24	1378	0.01	0.10	69661
Reason for no search is involuntary (0/1)	0.69	0.46	116	0.62	0.49	68930
Reason for no search is voluntary (0/1)	0.31	0.46	116	0.38	0.49	68930

Notes: This table shows the mean, the standard deviation, and the number of observations for the sample included in our survey (1314 respondents) and the sample of respondents in the 2017-2019 national labor force surveys conducted by the Agence Nationale de la Statistique et de la Demographie in Senegal .

1. Demographic information: This includes data on education, gender, age, and family structure.

2. Employment information: This module captures details such as employment status, type of employment, contract structure, industry, occupation, earnings, working hours, formality of employment, tenure in the current job, and any changes in employment over the past three months.

3. Job search: This module explores whether respondents engage in job search activities, the methods they employ in their job search, reasons for not actively seeking a job, and whether they were successful in finding employment.

4. Consumption expenditures: This module provides information on the amount of money

spent on food and beverages, utilities, housing, and any changes in these expenditures over the past few months.

5. Savings and borrowings: This module delves into the mechanisms used for saving and borrowing, the amount saved or borrowed, and whether the borrowing channels are formal or informal.

6. Elasticities of job exit rates and job search rates: To estimate the elasticities of job exit rates and job search rates, we asked respondents questions about the potential implementation of a worker protection program. Let X represent different values (5, 10, 25, 50, 100, and 200), and Y represent two timeframes (two months and six months). The variable Z corresponds to the respondent's salary, which was provided earlier in the survey. For unemployed individuals, their last earned salary was utilized. The main questions asked were as follows:

   - *Suppose the government puts in place a worker protection program over the next [Y] months, which would consist of offering each unemployed person [X% * Z] XOF per month during this period. Would you leave your current job (even if temporarily) during these [Y] months?*
   - *Suppose the government puts in place a worker protection program over the next [Y] months, which would consist of offering each unemployed person [X% * Z] XOF per month during this period. Would you stop looking for a job or stop trying to start a business?*

   The complete results can be found in Table 12, and the estimation methodology is discussed in Section B2 of the Appendix.

   To obtain comparable elasticities for formal and informal employment, the following questions were also asked:

   - *Suppose the government seeks to implement a worker protection program over the next [Y] months that would provide every worker with formal employment the equivalent of [Z] in case of job loss. If so, would you leave your current job to start an informal business or to do a new informal job?*
   - *Suppose the government seeks to implement a worker protection program over the next [Y] months that would provide every worker with formal employment the equivalent of [Z] in case of job loss. In this case, would you ask your employee to formalize your work status (if you are an employee) or be prepared to formalize*

the work status of your undeclared employees, including yourself (if you are an employer or self-employed)?

7. Risk aversion: This module explores respondents' risk preferences, particularly their preferences between a stable job and a second job with a comparable expected wage but higher variance.

8. General opinion toward a UI program: This section investigates respondents' opinions and attitudes toward a potential unemployment insurance (UI) program.

9. Peer effects: This module explores the influence of peers and social networks on individuals' employment decisions and outcomes.

The comprehensive data on the status and formality of employment is presented in Table 6. Using these data, we reconstructed the composition of the labor force in Senegal, which serves as a key input for our estimate. Our analysis reveals that the distribution of workers in Senegal consists of 18.8% formally employed individuals, 56.6% informally employed individuals, and 24.6% unemployed individuals actively seeking employment.

Table 6 provides a summary of responses on salary and family expenses. Using these data, we extrapolated information on individual consumption, which serves as a crucial input for our model. The estimated average consumption values are 74349.11 XOF for formally employed workers, 55168.81 XOF for informally employed workers, and 40739.65 XOF for unemployed individuals.

For a detailed explanation of the methodology employed to assess individuals' risk aversion, please refer to Section B1 in the Appendix. Our findings indicate that a significant proportion of individuals exhibit relatively high levels of risk aversion, resulting in an average risk aversion coefficient (σ) of 3.56.

4 Welfare Analysis

We estimate welfare under the three different models presented in Section 2. Table 2 provides a comprehensive overview of the parameters used to estimate these models, including their definitions, values, estimation methods, and sources. Panel A displays parameters directly estimated using the survey data, while panel B presents parameters computed or estimated from external sources.

See Section B in the Appendix for detailed step-by-step explanations of how each of these parameters is estimated.

Table 2: Model Parameters

Panel A: Parameters estimated from own data

Parameter	Description	Value	Source	Notes
σ	CRRA parameter	3.557	Survey	Consistent with Halek and Eisenhauer (2001)[a]
s0	Employment share	0.753	Survey	As fraction of total labor force
s_f	Share of formal workers	0.188	Survey	As fraction of the total labor force
s_i	Share of informal workers	0.565	Survey	As fraction of the total labor force
s_u	Unemployment share	0.247	Survey	Asfraction of the total labor force
β_{quit}	Marginal effect of UI on employment	(-0.358, -0.394)	Survey	1st and 2nd numbers are for 2-month and 6-month UI durations respectively
β_{search}	Marginal effect of UI on job search effort	(-0.391,-0.419)	Survey	1st and 2nd numbers are for 2-month and 6-month UI durations respectively
w	Salary	118,546.87	Survey	In XOF
b_0	Initial value of benefits	0.062	Survey	As fraction of the salary
c_e	Consumption of employed	60900.79	Survey	In XOF
c_u	Consumption of unemployed	(47,088.73, 40,739.65)	Survey	In XOF. The first number includes all unemployment consumption data. The second number uses only estimations of consumption drop due to unemployment
c_f	Consumption of formal workers	74,349.11	Survey	In XOF
c_i	Consumption of informal workers	55168.81	Survey	In XOF

Panel B: Parameters computed and/or externally determined

Parameter	Description	Value	Source	Notes
ε_u	Elasticity of unemployment	(0.090, 0.105)	Computed	1st and 2nd numbers are for 2-month and 6-month UI durations respectively
ε_{1-s_f}	Elasticity of non-formal employment	(0.027, 0.032)	Computed	1st and 2nd numbers are for 2-month and 6-month UI durations respectively
λ	Enforcement rate	0.5	External	Value for a hypothetical policy with limited enforcement

Notes: This table shows each parameter of the model specified in Section 2, the meaning of the parameter, its value used in our calculations, the method or source used to derive those values, and clarifying notes on meaning or sources.

[a] We conduct robustness checks with $\sigma = 2$

For our analysis of consumption-equivalent welfare gains, we consider two different approaches to policy implementation. First, we study the effects of a policy that is financed by a given tax rate (1% and 2%). We can think of this approach as the choice of a policymaker who wants to directly control the moral hazard implications and the feasability of the policy. Then, we study the effects of a policy that imposes a given level of benefits equal to 6090 XOF, which represents 10% of the mean employed consumption. In this case, we put an emphasis on the costs of the different policies. Since UI schemes grant the same amount of money to all people who can access them, this will naturally favor schemes with labor tax-based funding.

4.1 Large Welfare Gains with Zero Informality and Zero False Claims

In accordance with the zero informality and zero false claims scenario described in Section 2.2 (Model II), we set the proportion of the total labor force currently employed (standing at 75.3%) alongside the consumption level of all those employed, without differentiating between workers in the formal and informal sectors. Subsequently, we determine the labor search elasticities for all employed workers under various tax scenarios.

The results of our estimation exercise for zero informality and zero false claims are summarized in Table 3. Even with a relatively conservative tax base across all workers, the baseline Bailey-Chetty model predicts highly significant welfare effects in the absence of informality, with estimated gains between 1.40% and 1.64% for a 1% tax and 2.73% and 3.21% for a 2% tax. The large tax base due to the absence of informality and zero false claims eases funding the UI policy: raising the unemployment benefit to 10% of the employed consumption (6090 XOF) only requires a tax of 1.34% on all employed workers. As noted in the conceptual framework, the table underscores the intrinsic trade-off: a larger benefit level necessitates a more substantial tax base, which in turn reduces labor supply while augmenting the contribution from those who remain.

4.2 Reduced Welfare Gains in a labor-tax-funded UI System with High Informality

Although the welfare gains from incremental expansions of unemployment insurance (UI) are substantial in an economy characterized by zero informality and zero false claims, these findings rely on an idealized setting that significantly differs from labor markets with high levels of informality, such as the case in Senegal. In this section, we shift our focus to a more

Table 3: Benefit Changes Under Labor Income Tax with Zero Informality and Zero False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	2.88%	9.09%	5534.84	(1.40%, 1.64%)
2% Tax	2%	5.49%	11.70%	7124.70	(2.73%, 3.21%)
Constant UI benefit of 6090 XOF	1.34%	3.79%	10.00%	6090.08	(1.86%, 2.18%)

Notes: The first column specifies the tax rate or the level of benefits used to calculate the benefit changes of the corresponding row. The second column specifies the rate at which consumption is taxed for the taxable agents, which are all employed workers in this case of zero informality. The third column expresses the difference between the shares and the initial value of benefits b_0 (as a share of total salary). The fourth column expresses the benefit changes as a share of the consumption of the agents whose employment status is observed by the social planner (i.e., all employed workers in this case). The fifth column shows the benefit gains in XOF (XOF is the local currency in Senegal and 550 XOF $\approx$ 1 US dollar as of the time of the survey). The last column gives the percentage change in equivalent consumption that corresponds to the change in welfare. This consumption-equivalent change is calculated using the welfare obtained after the change in benefits (computed through the Bailey-Chetty formula) and setting it equal to the change in welfare when increasing all consumption values by x percent, keeping the share of workers constant.

realistic environment, as outlined in Section 2.1.1, where the government can only collect taxes from formal workers, while both the unemployed and informal workers are eligible to claim UI benefits due to limited enforcement.

In this experiment, we set the share of informal workers who receive unemployment benefits λ equal to the share of informal workers in the population. The results of our estimation exercise, summarized in Table 4, provide valuable insights that underscore the challenges and considerations associated with implementing an effective unemployment insurance (UI) system in labor markets characterized by high informality. We highlight two key points from our findings that emphasize the nuanced nature of welfare gains and the potential implications for policy design and implementation.

First, as anticipated, the gains achieved under limited enforcement exhibit a muted effect compared to the gains observed under zero informality and zero false claims. When accounting for the existence of non-taxable informal workers and false UI claims, the funds raised with a 1% and 2% tax are only enough to fund a less than 1% increase in the existing unemployment benefits, leading to welfare gains respectively in the range 0.28%-0.31% and 0.56%-0.62%. This discrepancy arises from the inherent limitations of the UI system, where only formal workers contribute, and the proportion of formal workers within the labor force is notably small. This finding underscores the intricate task of internally financing a realistic UI system within labor markets characterized by high informality. To generate meaningful welfare gains from UI, it becomes imperative to set the tax rate at an assertive level, given

the limited number of workers contributing to the system. While our sample provides a fairly representative picture, it is essential to acknowledge that estimated welfare gains may be further diminished in a sample with more informality, as observed in some labor markets across low-income African countries.

Second, a noteworthy pattern emerges as the tax rate surpasses certain thresholds, resulting in a positive difference between the tax rate and the benefit gains (expressed as a share of employed consumption). This disparity becomes increasingly pronounced as the level of benefits attained escalates. This observation suggests that achieving the intended policy objective may necessitate placing a substantial burden on the select few responsible for bearing the policy costs. In our experiment, in order to finance a benefit level of 6090 XOF, the policymaker must impose a 6.30% tax on formal workers. Such a burden introduces the possibility of behavioral responses among workers as they navigate the trade-offs between their individual economic decisions and the incentivizing effects of the UI program.

Table 4: Benefit Changes Under Formal Labor Income Tax with Informality and False Claims

Scenario	**Tax increase**	**Δ Benefit %**	**Benefit %**	**Benefit XOF**	c_{eq}%
1% Tax	1%	0.33%	6.54%	4862.43	(0.28%, 0.31%)
2% Tax	2%	0.66%	6.86%	5100.34	(0.56%, 0.62%)
Constant UI benefit of 6090 XOF	6.30%	1.99%	8.19%	6090.08	(1.74%, 1.94%)

Notes: The first column specifies the tax rate or the level of benefits that is assumed to calculate the benefit changes of the corresponding row. The second column specifies the rate at which we are taxing consumption for the taxable agents, which are all formal workers in this case. The third column expresses the difference between the shares and the initial value of benefits b_0 (as a share of the total salary). The fourth column expresses the benefit changes as a share of the consumption of the agents whose employment status is observed by the social planner (i.e., all employed workers in this case). The fifth column shows the benefit gains in XOF (XOF is the local currency in Senegal and 550 XOF $\approx$ 1 US dollars). The last column gives the percentage change in consumption equivalent that corresponds to the change in welfare. This consumption-equivalent change is calculated using the welfare obtained after the change in benefits (computed through the Bailey-Chetty formula) and setting it equal to the change in welfare when increasing all consumption values by x percent, keeping the share of workers constant.

The results presented in 4 depend on the chosen value of λ, the share of informal workers that manage to access UI. We will study how the welfare gains vary with λ in section 4.4.

4.3 VAT Funding Can Reap Large Welfare Gains

Subsections 4.1 and 4.2 underscore the challenges of implementing a practical unemployment insurance (UI) scheme in an environment characterized by high informality and weak enforcement. However, an additional constraint, not considered in these previous cases, pertains to the social planner's difficulty in identifying informal workers for the purpose of enforcing eligibility for UI benefits. To address these limitations, we now estimate welfare gains in the model presented in Section 2.3, which adopts a more feasible approach centered around a value-added tax (VAT). It is important to note that the results obtained from this model are applicable in a broader context and can be replicated using other broad-based revenue sources such as an inflation tax, a consumption tax, or external financing.

The results of the estimation exercise under broad-based taxation are summarized in Table 5. The results for this scheme are broadly between the two cases presented in Tables 3 and 4. Using broad-based taxation, policymakers are able to counteract the negative effects of informality on resource gathering. With the revenues gathered from a 1% and 2% increase in VAT, the government is able to offer a level of benefits respectively 700 XOF and 1400 XOF higher than with labor tax-based taxation. As a consequence, we obtain welfare gains larger than in the previous case. Furthermore, as a consequence of the broader tax base, there is no need to set the tax base at exceedingly high levels to achieve substantial gains. Our experiment shows that a benefit level of 6090 XOF can be reached with a 1.53% increase in VAT.

Table 5: Benefit Changes Under VA Taxation with Informality and False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	1.30%	7.51%	5583.62	(0.33%, 0.36%)
2% Tax	2%	2.59%	8.79%	6535.29	(0.65%, 0.72%)
Constant UI benefit of 6090 XOF	1.53%	1.99%	8.19%	6090.08	(0.50%, 0.55%)

Notes: The first column specifies the tax rate or the level of benefits that is assumed to calculate the benefit changes of the corresponding row. The second column specifies the rate at which we are taxing consumption for the taxable agents, which are all agents in this case. The third column expresses the difference between the shares and the initial value of benefits b_0 (as a share of total salary). The fourth column expresses the benefit changes as a share of the consumption of the agents whose employment status is observed by the social planner (i.e., all employed workers in this case). The fifth column shows the benefit gains in XOF (XOF is the local currency in Senegal and 1 XOF $\approx$ 550 US dollars). The last column gives the percentage change in consumption equivalent that corresponds to the change in welfare. This consumption-equivalent change is calculated using the welfare obtained after the change in benefits (computed through the Bailey-Chetty formula) and setting it equal to the change in welfare when increasing all consumption values by x percent, keeping the share of workers constant.

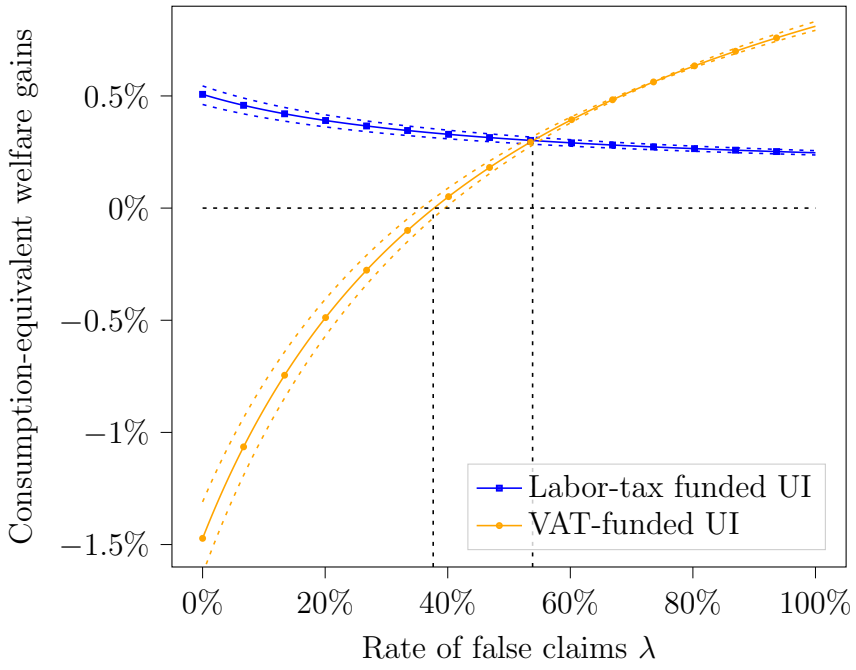
It should be noted that our results for this scheme are contingent on the value of λ, which we have set equal to the percentage of informal workers in the population. We will study how the welfare gains vary with λ in the next section.

4.4 Intuition: The Effect of Changes in the Rate of False Claims

In this section, we discuss the effectiveness of labor-tax-funded UI and VAT-funded UI with changes in λ. To do so, we repeat the experiment described in the previous sections and estimate the mean welfare gains financed by a 1% tax increase. The results are shown in Figure 1.

The graph shows that the two policies have opposite trends when λ increases. In the case of the labor-tax-funded UI system, an increase in the rate of false claims λ implies that the funds raised from taxing formal workers are shared with an increasing number of informal workers. As informal workers have a lower marginal utility of consumption, it reduces the overall effectiveness of UI. In the case of VAT financing, a low level of λ is inferior to the labor-tax-funded UI system because the policy only services the unemployed workers, but high-marginal utility agents partially finance it. However, when λ is high, the VAT allows for a better redistribution of the resources gathered, leading to an improvement

Figure 1: Mean consumption-equivalent welfare gains as a function of the rate of false claims λ



Notes: The figure shows the effects of a change in mean consumption-equivalent welfare gains for changes in the share of informal workers that manage to access UI (λ). The square-marked line represents the gains with a labor-tax-funded UI system, in which the tax is only paid by formally employed workers; the circle-marked line represents the gains with a VAT financing scheme. Dashed lines represent the 95% confidence intervals of consumption-equivalent welfare gains.

over the labor-tax-funded UI system. When the rate of false claims reaches 100% (that is, all informal workers can claim UI), the VAT funding brings consumption-equivalent welfare gains to its maximum of 0.81%, while the labor-tax-funded policy reaches its minimum at 0.25%. Finally, when the rate of false claims is sufficiently low, such as in economies with highly formalized labor markets, we recover the standard result that a VAT is regressive and can even lead to welfare losses, so the labor-tax-funded policy would be preferable.

In the context of our exercise, we estimate that the VAT policy is better than the labor-tax policy when the rate of false claims λ is above 53.5%. For a level of λ below 37.5%, the VAT policy has negative overall welfare effects.

In the subsequent section, we provide a robustness analysis to assess the validity of our findings across various levels of enforcement and tax evasion rates. Additionally, we examine the significance of informal transfers, investigate the sensitivity of the results to different values of risk aversion, and explore the implications of the informal labor market's size on the design of UI systems.

5 Robustness

5.1 Evasion of Consumption Tax

In this section, we examine the implications of evasion of the consumption tax on the effectiveness of a UI policy. We resolve for welfare effects of a change in the Ui benefits in a model with informality, false claims, and evasion of the consumption tax. Specifically, we assume that a portion λ of informal workers are able to purchase consumption through the informal market, thus evading the consumption tax. Table 6 presents the results of this analysis. In our analysis, we assume a value of $\lambda = 0.566$, the percentage of informal workers in the population.

Table 6: Benefit Changes Under Consumption Tax with Informality, False Claims and Tax Evasion

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	0.88%	7.09%	5356.50	(0.14%, 0.18%)
2% Tax	2%	1.75%	7.96%	6086.32	(0.28%, 0.36%)
Constant UI benefit of 6090 XOF	2.27%	1.99%	8.19%	6090.08	(0.32%, 0.41%)

The inclusion of tax evasion in the analysis introduces predictable changes. It not only results in a shift of resources toward relatively wealthier agents but also increases the tax burden on poorer agents. Consequently, the efficiency of the UI policy is diminished, and its overall cost escalates. This suggests that when implementing the UI system funded by a consumption tax, a value-added tax, which is less susceptible to evasion (Pomeranz, 2015), should be prioritized over a sales tax.

5.2 No Informal Transfers

In our survey, we specifically asked respondents whether they would have the ability to borrow money from informal lenders, individuals within their network, or any other informal sources in the event of job loss. The survey results indicate that approximately 24.6% of individuals have access to informal borrowing options during periods of unemployment. In this section, we explore the implications of assuming a complete crowding-out of informal transfers by the UI policy.

Tables 14, 15, and 16 present the results of our analysis for different UI financing scenarios. Notably, for labor tax-financed UI policies, we observe an efficiency loss ranging from 20% to 35%, with the magnitude of the loss increasing as the enforcement rate rises. For a 1% labor tax, the consumption-equivalent welfare gains in the presence of informality drop to 0.23%. In the case of a VAT-financed UI policy, unemployed workers who would have previously relied on informal transfers for free are now compelled to pay the additional tax, thereby substantially reducing the overall welfare effect of the policy, for a decrease in efficiency of around 55%. The consumption-equivalent welfare gains achievable with a 1% increase in VAT are in this case 0.16%.

5.3 Reduced Risk Aversion

The estimated coefficient of relative risk aversion from our survey exceeds the levels commonly employed in standard macroeconomic models but is consistent with studies that find a larger degree of risk aversion in low-income countries (Yesuf and Bluffstone, 2009). In addition, survey measures of risk aversion face limitations (Treibich, 2015). In this section, we explore the implications of reducing the coefficient to a standard value of $\sigma = 2$ within our analysis. As shown in Tables 17, 18, 19, this adjustment results in a reduction in the efficiency of the UI policy, with 0.16% consumption-equivalent welfare gains for labor tax financing methods, and around 0.25% for VAT financing, both following a 1% tax increase.

5.4 Reduced Formal Employment

It is important to note that our survey primarily focuses on the urban population, which may lead to an overrepresentation of formal workers compared to the true composition of the labor force in Senegal. Given that rural-agricultural work is often characterized by informality, our estimates may potentially overstate the share of formal workers. In this section, we re-evaluate our analysis by setting the share of formal workers to a conservative estimate of 10%.

This adjustment has a twofold impact on the efficiency of UI policies. Firstly, it increases the proportion of citizens eligible to receive UI benefits. However, simultaneously, it elevates the cost of the policy as a smaller payment is disbursed for the same tax rule imposed. Tables 20, 21 present the numerical results for these adjustments. Our main result still holds at lower shares of the formal employment with respectively 0.17% and 0.26% consumption-equivalent welfare gains for the 1% labor-tax-funded and the VAT-funded UI system.

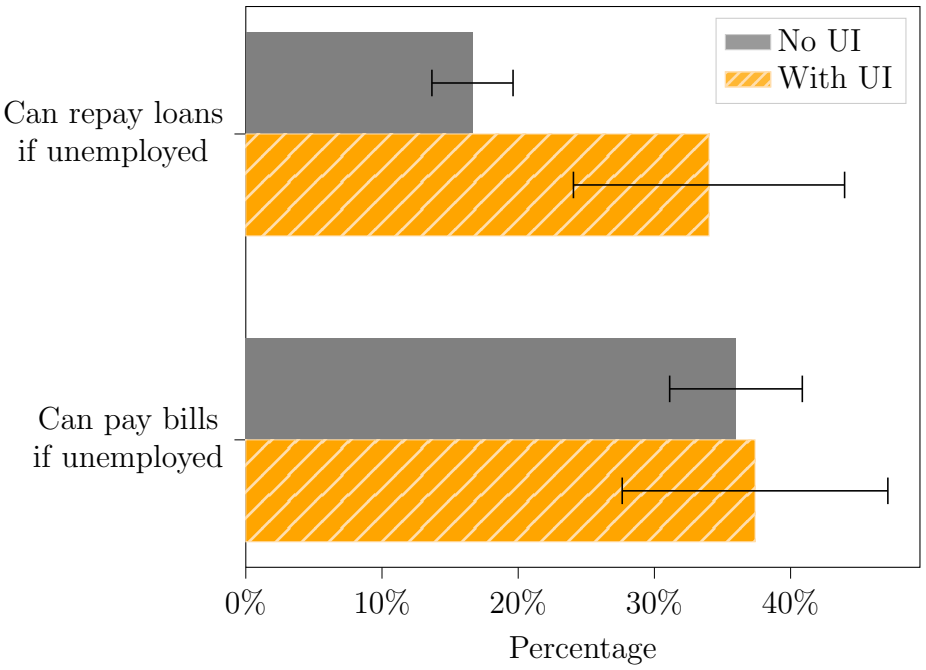
5.5 Credit Constraints and Default

Lastly, recent work by Braxton et al. (2020) and Bornstein and Indarte (2022) argue that private credit markets and public insurance are complementary. An expansion of the safety net does not crowd out private borrowing. It does precisely the opposite: a greater safety net reduces default rates and private credit markets expand. While a complete analysis is beyond the scope of the paper, we provide suggestive evidence that expanding the safety net in Senegal would reduce defaults. We ask our survey respondents two hypothetical questions to assess whether they would be able to meet their financial obligations in different scenarios. The specific questions asked can be found in section B4 of the Appendix.

To estimate the effects of a more easily implementable policy, we consider the subset of

respondents that was asked about a potential UI amount between approximately 5% and 25%, or between 5000 XOF and 30000 XOF. Table 11 reports the summary statistics of the results. Furthermore, we compared them to the baseline case with no UI in Figure 2. We find that the ability of job losers to make payments on loans improves with an expansion of the safety net, in agreement with the existing literature. This suggests that the safety will allow private credit markets to expand rather than crowding out private insurance opportunities. However, small amounts of UI don't significantly impact the ability to repay water and electricity bills.

Figure 2: Impact of UI on Loan Repayment and Financial Obligations

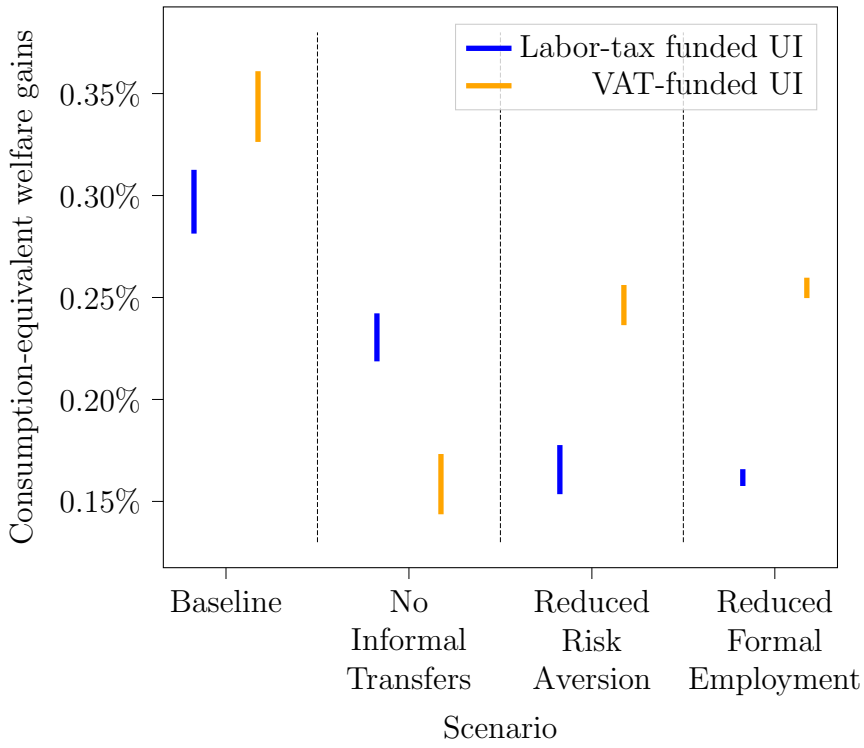


Notes: The figure shows the percentage of affirmative answers for the questions presented above. The first two bars represent the percentage of respondents who would be able to repay their loans in the event of unemployment, without Unemployment Insurance (UI) (solid bar), and with a UI in a range of 5000 XOF to 30000 XOF, approximately between 5% and 25% of the average salary (striped bar). The last two bars represent the percentage of respondents who would be able to pay their bills in the event of unemployment, without UI (solid bar), and with a UI in a range of 5000 XOF to 30000 XOF, approximately between 5% and 25% of the average salary (striped bar). The error bands represent the 95% confidence interval for the mean response.

Taking Stock: Figure 3 summarizes the results across all robustness exercises along with confidence intervals. The main takeaway is that the broad-based VAT-funded UI system achieves higher welfare than a labor-tax-funded UI system in a low-income economy with high levels of informality and weak enforcement. This result is robust to consumption-tax evasion, standard risk aversion levels, and higher informality. However, as the unemployed can gain consumption from informal transfers for free, a 100% crowd-out of informal transfers

can lower the benefits of the VAT-funded UI system relative to the labor-tax-funded one. Further research is needed to estimate such behavioral responses in this context.

Figure 3: Comparison of consumption-equivalent welfare under different robustness scenarios



Notes: The figure shows the consumption-equivalent welfare under the different scenarios we considered in our robustness analysis. The results represent the welfare effect of a 1% tax increase. In each case, the line on the left represents the gains with a labor-tax-funded UI system, in which the tax is only paid by formally employed workers, and the line on the right represents the gains with a VAT financing scheme.

6 Conclusion

This paper examines the welfare effects of unemployment insurance (UI) in economies characterized by high informality and low enforcement of UI eligibility criteria. Our survey findings indicate substantial drops in consumption following unemployment, along with high levels of risk aversion. However, moral hazard effects are relatively modest, as a significant portion of employed workers continue working even with relatively generous UI provisions. With substantial liquidity effects and limited moral hazard effects, UI has the potential to yield significant benefits in Senegal and low-income African countries with similar labor markets.

Ideally, UI should encompass the risk of income loss associated with informal work. Nevertheless, the challenges in verifying the work status and income of informal workers present practical hurdles in implementing such an unemployment insurance system. Given

that the informal sector constitutes the majority of employment in Senegal, identifying the appropriate individuals to tax for financing and distinguishing between unemployed claimants and informal workers posing as unemployed become daunting tasks. In a scenario where the government cannot effectively differentiate between informal employment and unemployment, the cost of financing UI can become prohibitively high. Our main result is that UI funded by a consumption tax (or value-added tax - VAT) can yield significant consumption gains even in the presence of high informality and high UI false claim rates.

Given these insights, we can derive some practical policy recommendations. As of 2022, Senegal's total public debt outstanding as a share of GDP stands at 76.6% of GDP, above the standard adopted within the framework of the West African Economic and Monetary Union (WAEMU)'s convergence pact. In addition, the "present value of [its] public debt payments and debt service to exports ratios have edged up nearing levels associated with a high risk of debt distress," according to the IMF.[5] To ensure long-term fiscal sustainability, it is crucial to implement macroprudential policies that are more cost-effective than non-targeted cash transfers. Accelerating the mobilization of local resources is equally essential. Unemployment insurance achieves this dual objective by enabling targeted stimulus policies for workers facing job loss during crises while fostering the formalization of work to broaden and establish a broader tax base.

The present study utilizes survey results where respondents express their behavioral changes under hypothetical schemes. Future research can further enhance our analysis by calibrating our benefit model with incentive-compatible behavioral responses to different UI schemes.

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Appendix A - Tables and Figures

A1 Tables

Table 7: Summary Statistics - Socioeconomic and Demographic Variables

Statistic	N	Mean	St. Dev.	Min	Max
General					
Is male	1,314	0.48	0.50	0	1
Is HH Head	1,314	0.24	0.43	0	1
Financial situation and dependency					
Is the only support of HH	1,314	0.12	0.32	0	1
Is the main support of HH	509	0.60	0.49	0	1
Financial situation of HH (1 = good, 3=bad)	1,314	2.36	0.63	1	3
Missed payments in L6M	1,314	0.20	0.40	0	1
Relative rank of HH (1=Low, 4 = High)	1,314	1.99	0.79	1	4
Total value of assets (000s XOF)	757	529.31	2,646.01	0	40,000
No. of financial dependents	1,309	2.44	3.49	0	28
Still at school	1,314	0.22	0.42	0	1
Education					
Has attended Coranic school	1,314	0.20	0.40	0	1
Never attended school	1,314	0.14	0.35	0	1
Attended primary school	1,010	0.27	0.45	0	1
Attended secondary school	1,010	0.48	0.50	0	1
Attended university	1,010	0.23	0.42	0	1
Has no diploma	1,294	0.45	0.50	0	1
Highest diploma is primary	1,294	0.18	0.39	0	1
Highest diploma is secondary	1,294	0.22	0.42	0	1
Highest diploma is university	1,294	0.15	0.35	0	1

Notes: This table shows the summary statistics for select variables from our own survey. HH stands for "household"; L6M stands for "last 6 months"; XOF is the Senegalese currency.

Table 8: Summary Statistics - Employment Status and Job Search

Statistic	N	Mean	St. Dev.	Min	Max
Employment status 3 months ago					
Was employed 3m ago	1,314	0.55	0.50	0	1
Employment 3m ago was self	1,314	0.24	0.43	0	1
Employment 3m ago was formal	1,314	0.10	0.30	0	1
Contract 3m ago was formal	1,314	0.12	0.32	0	1
Company 3m ago was formal	1,314	0.13	0.34	0	1
Employment status 7 days ago					
Was employed 7d ago	1,314	0.47	0.50	0	1
Employment 7d ago was self	1,314	0.24	0.42	0	1
Current employment status					
Currently employed	1,314	0.47	0.50	0	1
Current employment is self	1,314	0.22	0.42	0	1
Current employment is formal	1,314	0.09	0.29	0	1
Current contract is formal	1,314	0.11	0.32	0	1
Current company is formal	1,314	0.12	0.33	0	1
Job search					
Searched for a job L3M	1,314	0.15	0.36	0	1
Reason for no search L3M is involuntary	1,113	0.49	0.50	0	1
Found job upon search L3M	201	0.03	0.17	0	1
Accepted job after search L3M	10	0.80	0.42	0	1
Searched for a job L7D	201	0.42	0.50	0	1
Hrs searching for a job L7D	55	14.75	18.15	1	99
Reason for no search L7D is involuntary	116	0.69	0.46	0	1
Found job upon search L7D	85	0.01	0.11	0	1
Accepted job after search L7D	6	0.67	0.52	0	1

Notes: This table shows the summary statistics for select variables from our own survey. L3M stands for "last 3 months"; L7D stands for "last 7 days".

Table 9: Summary Statistics - Salary, Aid, and Consumption

Statistic	N	Mean	St. Dev.	Min	Max
Salary					
Monthly salary (000s XOF)	1,314	117.13	118.47	1.80	1,350.00
Expects a salary increase in NTM	617	0.45	0.50	0	1
Expects a salary decrease in NTM	617	0.02	0.15	0	1
Has no info about salary change NTM	617	0.36	0.48	0	1
Monthly expenditures					
Food expenditures (000s XOF)	392	142.87	74.75	15.00	600.00
Utilities expenditures (000s XOF)	387	51.76	331.63	0.00	6,500.00
Housing expenditures (000s XOF)	298	55.13	61.62	0.00	300.00
Other expenditures (000s XOF)	333	56.27	75.85	0.00	450.00
Total expenditures (000s XOF)	255	284.55	430.53	35.00	6,632.00
Expected change in expenditures if unemployed	298	7,906.04	6,583.84	0	50,000
Benefits					
Currently receives some aid	1,314	0.06	0.24	0	1
Total value of aid (000s XOF)	78	123.73	244.69	0	2,000

Notes: This table shows the summary statistics for select variables from our own survey.
NTM stands for "next 12 months"; XOF is the Senegalese currency.

Table 10: Summary Statistics - Savings, Bills, and Loan Payments

Statistic	N	Mean	St. Dev.	Min	Max
Bills					
Does not pay bill	377	0.17	0.37	0	1
Able to pay bills if unemployed	377	0.37	0.48	0	1
Can pay bills if receives UI when unemployed	377	0.76	0.43	0	1
Loans					
Does not have loans	617	0.44	0.50	0	1
Able to pay loans if unemployed	617	0.17	0.38	0	1
Can pays loans if receives UI when unemployed	344	0.70	0.46	0	1
Does not borrow from formal institutions	617	0.39	0.49	0	1
Can borrow from formal sources if unemployed	617	0.07	0.25	0	1
Expected loan from formal sources if unemployed (000s XOF)	25	756.80	1,632.51	0	7,000
Does not borrow from informal sources	617	0.36	0.48	0	1
Can borrow from informal sources if unemployed	617	0.24	0.43	0	1
Expected loan from informal sources if unemployed (000s XOF)	126	104.79	203.41	0	2,000
Savings					
Has a bank account	1,314	0.18	0.39	0	1
Has real estate investment	1,314	0.09	0.28	0	1
Has mobile money wallet	1,314	0.82	0.39	0	1
Saves salary at bank	177	0.50	0.50	0	1
Amount saved at bank (000s XOF)	52	89.13	150.73	10	1,000
Saves salary in real estate	81	0.26	0.44	0	1
Amount saved in real estate (000s XOF)	6	300.00	383.41	50	1,000
Saves salary in mobile wallet	573	0.40	0.49	0	1
Amount saved in mobile wallet (000s XOF)	193	28.27	23.15	0	100
Saves salary at home	617	0.23	0.42	0	1
Amount saved at home (000s XOF)	112	37.42	36.47	2	200

Notes: This table shows the summary statistics for select variables from our own survey.
XOF is the Senegalese currency.

Table 11: Summary Statistics - Bills and Loan Payments with random UI between 5% and 25% of average wage

Statistic	N	Mean	St. Dev.	Min	Max
Bills					
Able to pay bills if unemployed	377	0.37	0.48	0	1
Random value of UI	95	17029.22	6546.25	6125	29079
Can pay bills if receives UI when unemployed	95	0.37	0.48	0	1
Loans					
Able to pay loans if unemployed	617	0.17	0.38	0	1
Random value of UI	89	17462.63	6982.92	6043	29685
Can pays loans if receives UI when unemployed	89	0.34	0.48	0	1

Notes: This table shows the summary statistics for select variables from our own survey.

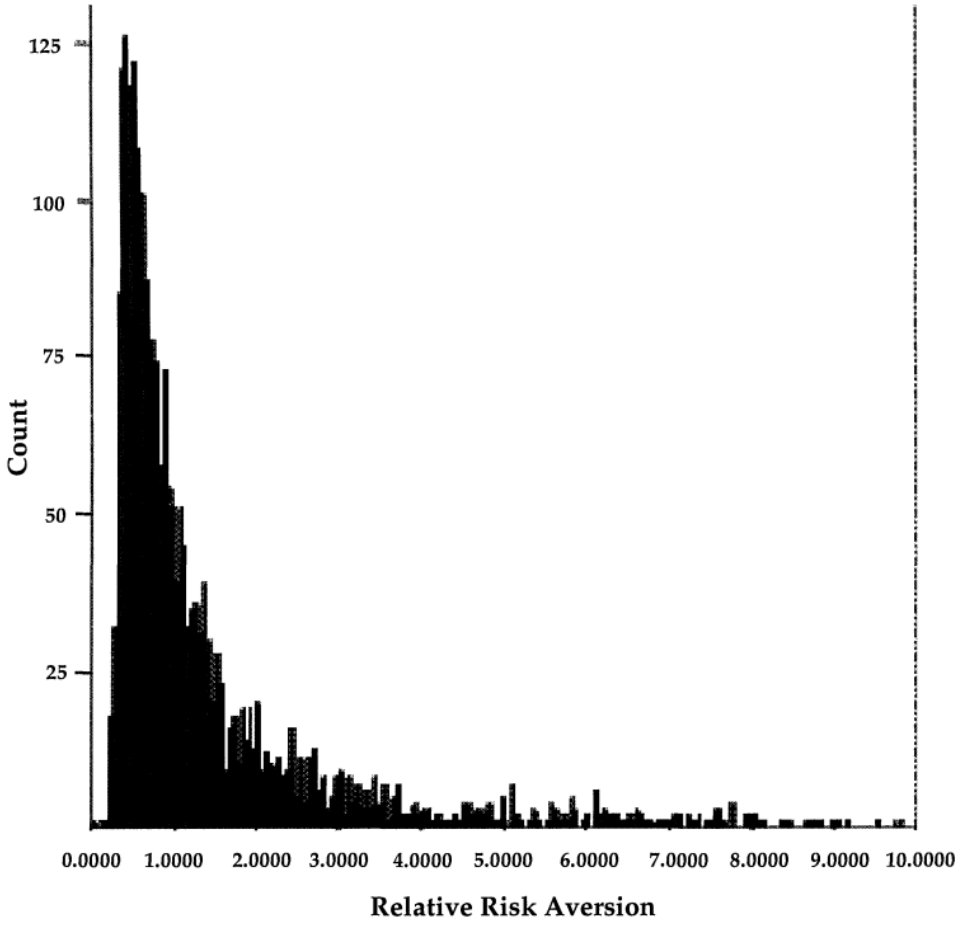
Table 12: Summary Statistics - Elasticities

Statistic	N	Mean	St. Dev.	Min	Max
Would quit job if received 10% of salary as UI for 2 months	617	0.01	0.09	0	1
Would quit job if received 25% of salary as UI for 2 months	617	0.03	0.17	0	1
Would quit job if received 50% of salary as UI for 2 months	617	0.14	0.34	0	1
Would quit job if received 100% of salary as UI for 2 months	617	0.42	0.49	0	1
Would quit job if received 200% of salary as UI for 2 months	617	0.66	0.47	0	1
Would quit job if received 10% of salary as UI for 6 months	617	0.01	0.09	0	1
Would quit job if received 25% of salary as UI for 6 months	617	0.03	0.18	0	1
Would quit job if received 50% of salary as UI for 6 months	617	0.14	0.35	0	1
Would quit job if received 100% of salary as UI for 6 months	617	0.44	0.50	0	1
Would quit job if received 200% of salary as UI for 6 months	617	0.73	0.45	0	1
Would stop job search if received 10% of salary as UI for 2 months	201	0.01	0.10	0	1
Would stop job search if received 25% of salary as UI for 2 months	201	0.04	0.21	0	1
Would stop job search if received 50% of salary as UI for 2 months	201	0.16	0.37	0	1
Would stop job search if received 100% of salary as UI for 2 months	201	0.44	0.50	0	1
Would stop job search if received 200% of salary as UI for 2 months	201	0.65	0.48	0	1
Would stop job search if received 10% of salary as UI for 6 months	201	0.01	0.10	0	1
Would stop job search if received 25% of salary as UI for 6 months	201	0.06	0.24	0	1
Would stop job search if received 50% of salary as UI for 6 months	201	0.21	0.41	0	1
Would stop job search if received 100% of salary as UI for 6 months	201	0.49	0.50	0	1
Would stop job search if received 200% of salary as UI for 6 months	201	0.75	0.44	0	1
Would quit job if there were UI program for formal jobs	122	0.22	0.42	0	1
Would move to informal sector if there were UI program for informal jobs	122	0.18	0.39	0	1
Would move to formal sector if there were UI program for formal jobs	171	0.75	0.44	0	1

Notes: This table shows the summary statistics for select variables from our own survey.

A2 Figures

Figure 4: Distribution of the coefficient of relative risk aversion



Notes: Figure shows the distribution of the coefficient of relative risk aversion in Halek and Eisenhauer (2001).

Appendix B - Model Estimation

B1 Risk aversion and marginal utilities

Our estimation of the marginal welfare change with respect to benefits requires us to estimate the marginal utilities of consumption for the employed and unemployed respondents in our sample. This estimation of the marginal utilities, in turn, requires estimating the risk aversion level of these respondents.

The risk aversion level is estimated from the responses to the three questions on willingness to participate in a hypothetical job lottery:

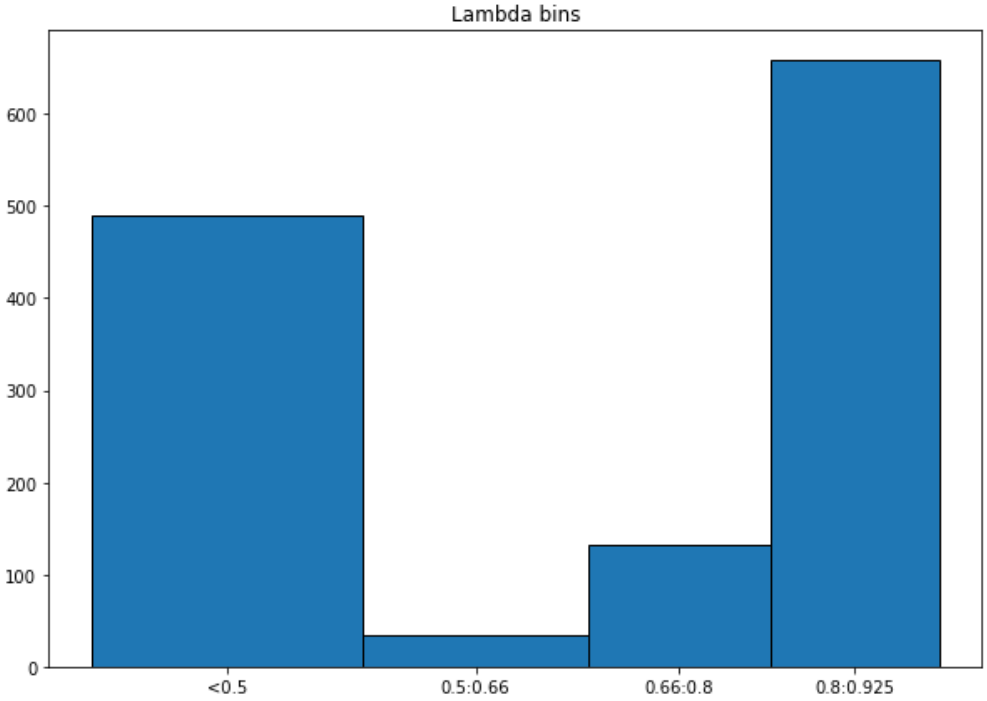
*Let's also assume that you are forced to change professions due to reasons beyond your control. You have the option to choose between two jobs. The first job guarantees a monthly salary of [Y] XOF. The second job offers: (i) a 50% chance of earning a monthly salary of [2*Y] XOF and (ii) a 50% chance of earning a monthly salary of [X * Y] XOF. Among the two options available to you, which one would you choose?*

We ask the question twice. The first time we used $X = 2/3$. The second time, we used $X = 1/2$ if they picked the lottery and $X = 4/5$ if they picked the safe job. This allows us to divide We map the answers on risk aversion back to theory, assuming that individuals have a von Neumann–Morgenstern utility function $u(\cdot)$ defined over lifetime income. For an individual who is exactly indifferent between job 1 (with a sure income y) and job 2 with a downside income of λy, the scale factor λ is implicitly defined by:

$$\frac{1}{2}u(2y) + \frac{1}{2}u(\lambda y) = u(y)$$

Depending on the answer given to the hypothetical questions, we can infer which of the following intervals the λ of the respondent belongs to $[0, \frac{1}{2}]$, $(\frac{1}{2}, \frac{2}{3}]$, $(\frac{2}{3}, \frac{4}{5}]$, or $(\frac{4}{5}, 1]$. Figure 5 shows the distribution of the values of λ after assigning an interval to each respondent based on their responses.

Figure 5: Bins of scale factor λ



Notes: This figure shows the distribution of the intervals in which fall the values of the scale factor λ of the respondents. The y-axis shows the number of respondents for each interval, and the x-axis shows the length of the interval.

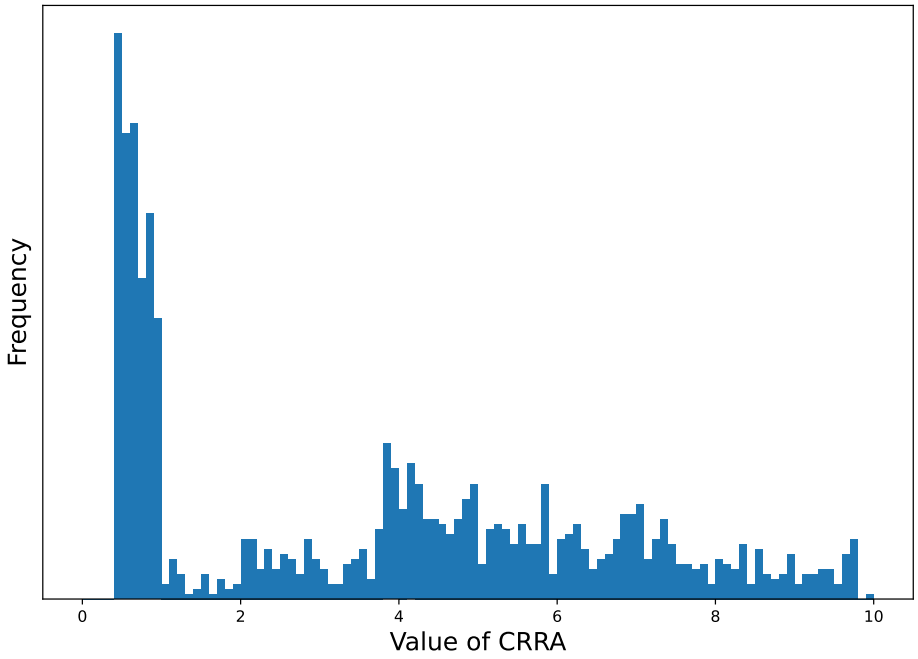
The distribution in Figure 5 is concentrated in the tails, which is at odds with usual representations of risk aversion in the literature. To deal with this issue, we parameterize the shape of our resulting distribution of the CRRA coefficients to that of US households, following Halek and Eisenhauer (2001) (see figure 4). To do so, we make the choice to have a hard cutoff for the possible values of the CRRA coefficient at about 0.4 on the left side and 9.9 on the right side. We then drew the value of λ to assign to each individual from uniform distributions inside their bins. For the two lowest and highest intervals, we used $\mathcal{U}(0.3, 0.5)$ and $\mathcal{U}(0.8, 0.925)$ respectively.

Under an assumption of CRRA, there is a one-to-one positive relationship between λ and the respondent's coefficient of relative risk aversion R, or $\frac{u''(\cdot)}{u'(\cdot)}$, as follows. We used an implicit function solver to find the exact value of the CRRA coefficient, using the formula

$$\lambda = (2 - 2^{(1-A)})^{\frac{1}{1-A}}$$

where A is the CRRA coefficient. Figure 6 displays the resulting distribution of the CRRA coefficient obtained from the above mapping:

Figure 6: Distribution of the CRRA parameter in our sample



Notes: This figure shows the distribution of the coefficient of relative risk aversion (CRRA) for the respondents in our sample. The x-axis shows the value of CRRA obtained for our sample, and the y-axis shows the frequency (in terms of count) corresponding to these values of CRRA.

The portion of the distribution between 1 and 4 is extremely low due to the low number of responses in the middle two bins for λ. Still, the mean of our CRRA distribution is close to that of the distribution from Halek and Eisenhauer (2001) (3.55720 against 3.7350).[6]

After having estimated the CRRA, we can now turn marginal utilities of consumption for the employed and the unemployed. We use data on the current expenditure level of respondents and focus on the answer to the question "*How much would your monthly expenditure decrease if you became unemployed?*". We take the answers to the question as referring to household expenditure and divide the reported expenditure by household size. The mean expenditure obtained for employed and unemployed individuals are respectively 60,900.79 XOF and 40739.65 XOF.[7]

[6] As an alternative to the uniform distribution, in order to keep low density for extreme CRRA values, we could use a translated exponential distribution, but such approach requires a careful parameterization of the distribution.

[7] The levels of consumption we obtain seem to be consistent with secondary data. Using data from the World Bank (WB), we see that the GDP per capita in Senegal in 2020 was 1,487.76$, or 818,519.15 XOF.

B2 Elasticities

Then, we need the elasticities of job exit rate and job search rates with respect to benefits to compute the marginal welfare of UI. Here, we run these weighted regressions using the probability weights given by ANSD:

$$\text{stay} = (1 - \text{quit\_job}) = \alpha + \beta \cdot \text{benefit\_fraction}$$

and

$$\text{keep\_search} = (1 - \text{stop\_search}) = \alpha + \beta \cdot \text{benefit\_fraction}$$

Here, *stay* is a dummy variable for whether the worker would stay with their current employment, and *quit_job* is a dummy for whether the worker would quit their jobs. *keep_search* is a dummy variable for whether the worker would keep searching for a job, and *stop_search* is a dummy for whether the worker would stop searching for a job. $benefit\_fraction$ is the share of the salary that would be given as UI benefits. The results of the linear probability model are given in table 13.

Table 13: Linear Probability Model

	Stays with job		Keeps searching	
	2-month UI	6-month UI	2-month UI	6-month UI
	(1)	(2)	(3)	(4)
Share of salary given as UI	−0.35768***	−0.39414***	−0.39142***	−0.41850***
	(0.00921)	(0.00907)	(0.02409)	(0.02454)
Observations	3085	3085	470	470
R^2	0.328	0.380	0.361	0.383

Notes: This table shows the changes in employment behavior with respect to the level of UI benefits. The independent variable in all four regressions is the share of the respondent's salary that would be given as UI benefits. The dependent variable for column (1) is the likelihood of staying employed with a UI duration of 2 months. The dependent variable for column (2) is the likelihood of staying employed with a UI duration of 6 months. The dependent variable for column (3) is the likelihood of continuing to search for a job with a UI duration of 2 months. The dependent variable for column (4) is the likelihood of continuing to search for a job with a UI duration of 6 months. Significance codes: ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

The coefficients in Table 13 are significant at the 0.1% level.[8]

Taking the monthly value and considering a weight of consumption on total GDP of 82.3% (again using WB data), we get an average monthly consumption of 56,136.77 XOF, which is consistent with our findings.

[8]We also use dummies for each individual and/or household, but they don't change the result at all.

To integrate these results with the current level of employment, we use the coefficient of job quitters as a proxy for the decrease in employment due to an increase in unemployment benefits. Given a starting level of benefits equal to 6.206% of salary income and the unemployment rate of 0.24727 found above, we derive an elasticity of unemployment to benefits ranging from 0.0898 to 0.1050.

B3 Derivative of the budget constraint with respect to benefits

$$\frac{\partial \frac{C^f b(1-(1-\lambda)s^i(b)-s^f(b))}{C^f \lambda b s^i(b)+(C^f b+C^u)(1-s^i(b)-s^f(b))+C^f s^f(b)+C^i s^i(b)}}{\partial b} =$$

$$\underbrace{-\frac{c_f b(1-(1-\lambda)s_i(b)-s_f(b))\left(c_f \lambda b s_i'(b)-(c_f b+c_u)\left(s_i'(b)+s_f'(b)\right)+c_f\lambda s_i(b)+c_f(1-s_i(b)-s_f(b))+c_f s_f'(b)+c_i s_i'(b)\right)}{(c_f\lambda b s_i(b)+(c_f b+c_u)(1-s_i(b)-s_f(b))+c_f s_f(b)+c_i s_i(b))^2}}_{\text{effect on the taxable base}}$$

$$\underbrace{-\frac{c_f b\left((1-\lambda)s_i'(b)+s_f'(b)\right)}{c_f\lambda b s_i(b)+(c_f b+c_u)(1-s_i(b)-s_f(b))+c_f s_f(b)+c_i s_i(b)}}_{\text{effect on UI applicants}}+\underbrace{\frac{c_f(1-(1-\lambda)s_i(b)-s_f(b))}{c_f\lambda b s_i(b)+(c_f b+c_u)(1-s_i(b)-s_f(b))+c s_f(b)+c_i s_i(b)}}_{\text{effect on benefit expenses}}$$

B4 Meeting of financial obligations

To estimate the ability to meet financial obligations we discuss in Section 5.5, the questionnaire asks the following two questions:

If you were to lose your job today and the government offered you X XOF per month for two months, would you be able to pay off the debts you have incurred from formal financial institutions, informal lenders, individuals within your network, or any other sources for this month? If you were to lose your job today and the government offered you Y XOF per month for two months, would you be able to pay your water and electricity bills for this month?

Where X and Y are a random amount of XOF between 0 and 120,000. The first question concerns the ability of repaying outstanding loans, while the second the repayment of utilities.

Appendix C - Robustness checks tables

C1 Infinite elasticity of informal transfers

Table 14: Benefit Changes Under Labor Income Tax with Zero Informality and Zero False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	2.88%	9.09%	5534.84	(0.91%, 1.08%)
2% Tax	2%	5.49%	11.70%	7124.70	(1.76%, 2.10%)
Constant UI benefit of 6090 XOF	1.34%	3.79%	10.00%	6090.08	(1.21%, 1.43%)

Table 15: Benefit Changes Under Formal Labor Tax with Informality and False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	0.33%	6.54%	4862.43	(0.22%, 0.24%)
2% Tax	2%	0.66%	6.86%	5100.34	(0.44%, 0.48%)
Constant UI benefit of 6090 XOF	6.30%	1.99%	8.19%	6090.08	(1.34%, 1.49%)

Table 16: Benefit Changes Under Consumption Tax with Informality and False Claims

Scenario	**Tax increase**	**Δ Benefit %**	**Benefit %**	**Benefit XOF**	c_{eq}%
1% Tax	1%	1.30%	7.51%	5583.618161	(0.14%, 0.17%)
2% Tax	2%	2.59%	8.79%	6535.29	(0.29%, 0.34%)
Constant UI benefit of 6090 XOF	1.53%	1.99%	8.19%	6090.08	(0.22%, 0.26%)

C2 Risk aversion coefficient

Table 17: Benefit Changes Under Labor Income Tax with Zero Informality and Zero False Claims

Scenario	**Tax increase**	**Δ Benefit %**	**Benefit %**	**Benefit XOF**	c_{eq}%
1% Tax	1%	2.88%	9.09%	5534.84	(0.65%, 0.77%)
2% Tax	2%	5.49%	11.70%	7124.70	(1.25%, 1.48%)
Constant UI benefit of 6090 XOF	1.34%	3.79%	10.00%	6090.08	(0.86%, 1.02%)

Table 18: Benefit Changes Under Formal Labor Tax with Informality and False Claims

Scenario	**Tax increase**	**Δ Benefit %**	**Benefit %**	**Benefit XOF**	c_{eq}%
1% Tax	1%	0.33%	6.54%	4862.43	(0.15%, 0.18%)
2% Tax	2%	0.66%	6.86%	5100.34	(0.31%, 0.35%)
Constant UI benefit of 6090 XOF	6.30%	1.99%	8.19%	6090.08	(0.93%, 1.18%)

Table 19: Benefit Changes Under Consumption Tax with Informality and False Claims

Scenario	**Tax increase**	**Δ Benefit %**	**Benefit %**	**Benefit XOF**	c_{eq}%
1% Tax	1%	1.30%	7.51%	5583.618161	(0.24%, 0.26%)
2% Tax	2%	2.59%	8.79%	6535.29	(0.47%, 0.51%)
Constant UI benefit of 6090 XOF	1.53%	1.99%	8.19%	6090.08	(0.36%, 0.39%)

C3 Reduced formal population

Table 20: Benefit Changes Under Formal Labor Tax with Informality and False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	0.20%	6.37%	4736.04	(0.16%, 0.17%)
2% Tax	2%	0.36%	6.53%	4855.00	(0.31%, 0.33%)
Constant UI benefit of 6090 XOF	13.32%	1.99%	8.19%	6090.08	(2.00%, 2.11%)

Table 21: Benefit Changes Under Consumption Tax with Informality and False Claims

Scenario	Tax increase	Δ Benefit %	Benefit %	Benefit XOF	c_{eq}%
1% Tax	1%	1.11%	7.32%	5442.35	(0.25%, 0.26%)
2% Tax	2%	2.22%	8.42%	6260.20	(0.50%, 0.52%)
Constant UI benefit of 6090 XOF	1.79%	1.99%	8.19%	6090.08	(0.45%, 0.46%)

Appendix D - Context of Study

This study on the welfare impacts of UI is done in the context of the Senegalese labor market, which is characterized by three major facts. First, in terms of demand for employment, more than half of the working population is under 35 years old (56%) and is unemployed (54%).

It is, therefore, important to protect these workers against job loss. Second, in terms of job offers, more than half (60%) of workers in formal enterprises are not officially declared. Later in this section of the Appendix we define the key terms relevant to this study and discuss recent trends in the Senegalese labor market based on labor force surveys conducted by Agence Nationale de la Statistique et de la Démographie (ANSD).

Of particular relevance to this study are the transition rates of individuals between formal work, informal jobs, and no job at all. Table 22 is the transition matrix for all respondents of the Enquête Nationale sur l'Emploi au Sénégal (ENES)[9] between 2017 and 2019. Table 23 only uses responses from people that appeared in multiple consecutive ENES surveys.

Table 22: Transition matrix for workers in the Senegalese labor force surveys

	Formal employment	Informal employment	Unemployment
Formal employment	23%	38%	39%
Informal Employment	3%	53%	44%
Unemployment	2%	34%	64%

Notes: This table shows the share of workers moving between different states of employment in the ENES. All respondents are included in the calculations. The status at time t is shown on the left side of the table, while the status at time $t+1$ is shown on the top side of these two tables.

Table 23: Transition matrix for workers in the Senegalese labor force surveys

	Formal employment	Informal employment	Unemployment
Formal employment	6%	43%	51%
Informal Employment	3%	52%	45%
Unemployment	2%	38%	60%

Notes: This table shows the share of workers moving to different states of employment in the ENES. Only respondents that appear in multiple consecutive ENES surveys are included. The status at time t is shown on the left side of the table, while the status at time $t+1$ is shown on the top side of these two tables.

Both tables 22 and 23 show mobility across different work statuses. We make three observations from these tables. First, there is a high level of mobility across the three work statuses. Table 23 shows that of workers with formal employment in one round of the ENES, 43% have moved to the informal sector, and 51% have become unemployed by the

[9]ENES is the labor force survey in Senegal.

next round. Similarly, of workers with informal employment in one round of the ENES, 51% have moved to becoming unemployed in the next round. Second, the movement toward the formal sector is very muted. Only 6% manage of workers in the formal sector manages to stay in the formal sector in the next round, while the transition to the formal sector is even lower for people who are unemployed or who have informal unemployment. Third, there is a considerable movement of workers out of unemployment, with 40% of unemployed people managing to find work in the next round.

We highlight below some key terms and discuss recent trends in the Senegalese labor market based on recent labor force surveys conducted by Agence Nationale de la Statistique et de la Démographie (ANSD).

Working age population

The working-age population includes all persons who are older than the minimum age required to be able to participate in economic production activity as defined by the United Nations System of National Accounts (SNA). In the case of Senegal, this population is made up of individuals aged 15 or over, all genders combined. The results of the national survey on employment in Senegal (ENES) reveal that the population of working age is predominantly male at the national level and in urban areas. However, in rural areas, more than half of the population of work are women (53.8% in 2017 and 53.5% in 2018).

Labor force

The labor force includes all persons of both genders who, during a specified reference period, supply their labor for the production of goods and services as defined in the national accounting system. It is measured against a reference period which is generally a week or seven days. It is equal to the sum of people of working age who are economically active and those who are unemployed. In Senegal, nearly six (6) out of ten (10) people of working age are in the workforce (58.4% in 2017, 59.8% in 2018, and 61.3% in 2019).

The labor force participation rate is lower among women regardless of the year and place of residence considered. Indeed, the gap between the labor force participation rate of men and that of women is almost twenty (20) percentage points. In addition, the participation rate increases with age and, for every three years, remains higher among people aged 35 to 44 years. It is lower in young people (15-24 years) and the elderly (60 years and over).

Unemployment

Is considered unemployed any person 15 years or older who did not have a job, had made arrangements to look for work during a specified recent period, and was currently available for employment if they were able to do so (ILO, 2013). The unemployment rate is the proportion of unemployed people in the labor force. In 2018, the unemployment rate was 15.5% compared to 15.9% in 2017. The unemployment rate varies according to age group, gender, and level of education. Indeed, regardless of the place of residence and the year considered, it remains higher for women than for men. In addition, the unemployment rate is higher among young people aged 15 to 34, regardless of their place of residence. From the age of 60, a slight increase is observed. In addition, in 2017, the highest unemployment rates were observed among people with higher (20.4%) and secondary (18.0%) levels.

Employment rate

The employed population includes all persons involved in the production of goods and services, even if only for one hour, during a brief reference period (the last seven days preceding the day of the interview), and all persons normally employed but absent from their work. The employment rate is a measure of the use of available labor in the economy for the production of goods and services as defined in the national accounts. It measures the share of people in employment, i.e., in paid employment, among people of working age. In Senegal, the employment rate was 43.0% in 2017, 44.5% in 2018, and 43.8% in 2019. There are disparities between men and women: among women, less than 40% of the workforce is employed against nearly six (6) out of ten (10) men.

Most of the employed labor force is in vulnerable employment (self-employed or caregivers). In 2018, 62.7% of jobs (74.5% for women and 55.4% for men) were vulnerable. These proportions were 65.5%, 78.5, and 57.4% in 2019. Of particular relevance to this study is the fact that people in vulnerable jobs are less likely to be in formal employment or to benefit from social benefits or social protection programs and are more exposed to economic cycles.

Formal vs. informal employment

Individuals in informal employment are those whose employment is not subject, by law or in practice, to national legislation, employment, income tax, worker protection, or the right to certain benefits (e.g., notice in the event of dismissal, severance pay, paid annual

leave or sick leave, etc.). Thus, employees (formal or informal) are in informal employment if at least one of the following conditions is not met:

- Payment by the employer of social security protection allowance
- Paid sick leave
- Compensated annual leave or possible compensation

In 2017, almost all employed people (96.4%) were in informal employment. This observation is valid for all institutional sectors. However, informal employment is more noted in the household sector (99.6%) and the private sector. The public sector concentrates 33.2% of formal employment.

Analysis by gender suggests that women are more exposed to informality, with 98.1% of jobs being informal compared to 95.1% for men. Analysis by gender by sector shows that in the agricultural sector, the majority of employed people have informal jobs (99.6% for men and 99.9% for women). Analysis by age group shows that the rate of informality decreases with age up to 54 years. From the age of 55, it increases to become more important for employed people aged 65 or over, where it is 99.0%. Analysis by sector shows that there is no informal employment in international organizations. While in the household sector, jobs are mostly informal.

In 2017, the majority of employees declared that they worked on the basis of a verbal agreement (47.0%) or without a contract (21.1%). The proportion of employees with a written contract of indefinite or fixed duration was 19.3% and 12.5%, respectively.