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Unemployment insurance and uncertainty: Theoretical modelling of risks and incentives

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Abstract

This article develops a theoretical model of unemployment insurance under uncertainty, combining risk and insurance theory (Knight, 1921; Allais, 1953; Borch, 1968, 1990) with growth and automation models (Zeira, 1998; Aghion et al., 2017). The model analyses both direct and indirect effects of unemployment insurance on unemployment duration and labour market equilibrium. The direct channel increases the reservation wage, reducing individual uncertainty but potentially prolonging unemployment. The indirect channel reflects distortions in hiring incentives and firm financing, which may either raise structural unemployment or improve job–worker matching depending on productivity distribution. The originality of the framework lies in formalising the balance between these two channels through the condition $E\_D \gtrless |E\_IND|$. This extends existing models (Albrecht and Axell, 1984; Eckstein and Wolpin, 1990; Schmieder and Von Wachter, 2016) by embedding micro level analyses into a broader equilibrium structure. The results highlight that the optimal design of unemployment insurance must balance protection and incentives, adapt benefits to heterogeneous preferences, and account for labour market structures. This is particularly important in developing economies where stabilisation and inclusiveness are essential.

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1. Introduction

Unemployment insurance refers to the system whereby the state or a local authority offers protection to people facing the risk of losing their jobs by providing them with a replacement income. Based on the concepts of economic insurance and risk management, its aim is to reduce the personal uncertainty associated with the duration of unemployment and to ensure the stability of labour market. Several studies have theoretically examined the potential impact of unemployment insurance on the duration of unemployment and on the balance of the labour market. Albrecht and Axell (1984) demonstrating that unemployment insurance has an impact on individuals' reservation wages. Eckstein and Wolpin (1990) incorporate diversity among individuals and firms into the model developed by Albrecht and Axell (1984) and highlight the distribution of unemployment spells. More recently, Xu (2022) shows that the impact of unemployment insurance is strongly influenced by personal preferences for leisure and firm productivity.

The effect (direct and indirect) of unemployment insurance on individual actions (reservation wage, duration of unemployment) and on the equilibrium of the labour market through incentives and financing by companies is explained by economic analysis (Schmieder and Von Wachter, 2016). This outcome can be ambiguous when considering moral hazard, heterogeneous preferences, corporate taxation, and financing distortions. Unemployment insurance has the potential to extend the period of unemployment by raising reservation wages. It can optimise job-worker matching.

In an environment characterised by repeated economic crises, technological developments (AI, automation) and ecological transitions, the issue of the sustainability and effectiveness of unemployment benefits becomes increasingly pressing (Acemoglu et al., 2026; Almusharraf, 2025). In this article, we aim to demonstrate, through theoretical modelling, the dual role of unemployment insurance in a context of uncertainty. We attempt to determine on the one hand the circumstances in which unemployment insurance can promote a collective well-being or conversely, cause inefficiencies and prolong unemployment on the other hand. We develop a model inspired by the research of Knight (1921), Allais (1953) and Borch (1968, 1990) on risk and insurance, which we integrate into the logic of growth and automation models (Zeira, 1998; Aghion et al., 2017).

Our research offers two innovative contributions to the literature. On the one hand, it proposes a link between risk theory and growth models to examine unemployment insurance. On the other hand, it demonstrates that the total effect of this insurance is conditioned by a comparison between its direct and indirect consequences. Our model bridges the gap between risk and insurance theory (Knight, Allais, Borch) and growth and automation models (Zeira, Aghion). Unlike traditional approaches, which separate individual incentives from market distortions, we propose an integrated equilibrium function that assesses all direct and indirect effects. This makes it possible to determine precisely when unemployment insurance improves collective welfare or, conversely, generates inefficiencies. The article is structured as follows: the first part sets out the theoretical basis and conceptual framework; the second part explores the modelling of direct and indirect effects; the third one discusses the results; and finally, the conclusion highlights the prospects for social policy reform.

2. Theoretical foundations and conceptual framework

Unemployment insurance system is a form of social protection that reduces the personal uncertainty associated with the threat of job loss. The analysis of unemployment insurance in an uncertain context dates back to early work on risk and insurance.

Knight (1921) initiated reflection on people's behaviour in the face of risk and mutualisation processes, distinguishing between measurable risk and unquantifiable uncertainty. Indeed, redundancy can be considered a probabilistic risk, while the duration of unemployment and the intensity of job searching correspond to a deeper uncertainty. Unemployment insurance therefore sits at the intersection of these two aspects, as it seeks to convert individual uncertainty into a manageable collective risk through mutualisation (Barry, 2024). Following on from Knight's work, Allais (1953) demonstrated that individuals' actual reactions to risk do not always follow the classic axioms of rationality. His paradox shows that people may opt for lower certainty rather than uncertainty that could offer greater expected gains. Allais therefore emphasises the heterogeneity of preferences and the non-linear nature of risk behaviour. Some prefer to prolong their period of unemployment in order to enjoy leisure time, while others intensify their job search in order to reduce uncertainty (Lachowska et al., 2022).

Borch (1968, 1990) subsequently summarised the economics of uncertainty and insurance, emphasising the logic of risk sharing and incentives. According to Borch, insurance is a transfer mechanism designed to distribute losses among the members of a community. However, it must be designed in such a way as to prevent opportunistic behaviour. Unemployment insurance highlights this dilemma. It offers protection to people in the event of loss of income, but it can also create moral hazard by encouraging some people to reduce the intensity of their job search. Borch's contribution is that he demonstrates that insurance cannot be examined solely from the perspective of coverage, but also as an implicit contract.

Knightian uncertainty, which cannot be quantified by probability, transforms the labour market by introducing non-random variability into reservation wages and productivity levels. This approach draws on Knight's distinction between risk and uncertainty, Allais's paradox (diverse reactions to risk), and Borch's logic of mutualisation and incentives. The model shows that unemployment insurance converts individual uncertainty into a mutualised collective risk, whilst influencing the macroeconomic equilibrium. Knight highlights the difference between risk and uncertainty, Allais explores various responses to risk, while Borch structures the logic of mutualisation and incentives. Taken together, these elements show that unemployment insurance serves as a response to uncertainty and generates heterogeneous behaviour. At the same time, it constitutes a collective mechanism that must respect balance requirements.

This conceptual framework can be integrated with more current models of growth and automation (Zeira, 1998; Aghion et al., 2017), highlighting the direct and indirect effects of policies or innovations. Unemployment insurance has a direct effect on the duration of unemployment and an indirect influence on the equilibrium of labour market (Hartung et al., 2026; Schmieder et Von Wachter, 2016). Thus, the originality of our approach lies in merging these two traditions. On the one hand, there is risk and insurance theory, which forms the basis for interpreting individual behaviour and incentives; on the other hand, there is the logic of growth models, which offers a systemic view for understanding direct and indirect effects.

Consequently, the conceptual and theoretical model we propose is based on an interaction between microeconomics and macroeconomics. It also links individual behaviour and collective equilibrium.

3. Theoretical modelling of risks and incentives

We consider an economy composed of heterogeneous individuals according to their preference for leisure v and their productivity A. When an individual is unemployed, they receive unemployment benefit b. This unemployment insurance system is financed by firms through a lump-sum tax t. The behaviour of each individual is described by an intertemporal utility

function that depends on consumption c and leisure l. Inspired by Allais (1953) and Borch (1968), this function is defined as follows:

$$U(c,l) = c^{\alpha} l^{1-\alpha}, 0 < \alpha < 1 \quad (1)$$

This formulation illustrates that consumption and leisure are complementary, in accordance with the intuition of Veblen (1899).

3.1. Individual decisions: reservation wage

The reservation wage w^* is determined by the equality between the utility of remaining unemployed (benefit b, leisure v) and the utility of working (wage w, reduced leisure).

An individual compares the utility of remaining unemployed with that of working.

When unemployed, the utility is:

$$U_{unemployed} = b^{\alpha} v^{1-\alpha} \quad (2)$$

When employed, with a wage w and a loss of leisure time δ, utility is:

$$U_{employed} = w^{\alpha} (v-\delta)^{1-\alpha} \quad (3)$$

In fact, an unemployed individual receives an allowance b and has leisure time v. Furthermore, if they accept a paid job with a salary w, his leisure time is reduced to $v-\delta$, where δ represents the loss of leisure time due to work.

The reservation wage w^* is defined by the equality of the two utilities:

$$b^{\alpha} v^{1-\alpha} = w^{\alpha} (v-\delta)^{1-\alpha} \quad (4)$$

Isolating w, we obtain:

$$w^* = \left(\frac{b^{\alpha} v^{1-\alpha}}{(v-\delta)^{1-\alpha}} \right)^{1/\alpha} \quad (5)$$

This equation shows that w^* increases with b and v. The higher the benefit and the stronger the preference for leisure, the higher the reservation wage becomes, which prolongs the duration of unemployment. The direct effect of unemployment insurance is measured by the elasticity:

$$E_D = \frac{\partial w^*}{\partial b} \quad (6)$$

Differentiating (5), gives:

$$\frac{\partial w^*}{\partial b} = \frac{1}{\alpha} \left(\frac{v}{v-\delta} \right)^{1-\alpha} \times b^{1/\alpha - 1} > 0 \quad (7)$$

Thus, any increase b increase w^* and prolongs the duration of unemployment.

3.2. Business decisions: profit and recruitment requirements

According to neoclassical theory, from the perspective of firms, production is assumed to be linear in terms of labour:

$$Y = A \times L \quad (8)$$

where A is productivity and L is the amount of labour employed.

Companies operate with productivity A and are required to pay wages w. They finance unemployment insurance through a tax t. So t reduces the company's profit:

$$\pi = A \times L - w \times L - t \quad (9)$$

where $A \times L$ is the value of production; wL is the wage bill; and t is the flat-rate tax (contribution to unemployment insurance).

The condition for hiring is:

$$w \leq A - \frac{t}{L} \quad (10)$$

Tax t therefore reduces the net productivity available to pay for labour, which limits companies' ability to recruit. This is because companies hire if the proposed wage w is lower than their marginal productivity A.

3.3. Labour market balance

The equilibrium unemployment rate corresponds to the proportion of individuals whose reservation wage exceeds firms' productivity:

Thus:

$$u^* = Pr(w^* > A) \tag{11}$$

Substituting w^*, gives:

$$u^* = Pr\left(\left(\frac{b^{\alpha} v^{1-\alpha}}{(v-\delta)^{1-\alpha}}\right)^{1/\alpha} > A\right) \tag{12}$$

With the tax, the condition becomes:

$$u^* = Pr\left(\left(\frac{b^{\alpha} v^{1-\alpha}}{(v-\delta)^{1-\alpha}}\right)^{1/\alpha} > A - \frac{t}{L}\right) \tag{13}$$

Thus, tax t acts as a disturbance that reduces companies' ability to recruit.

We can therefore write the equilibrium function as follows:

$$u^* = g(b, t, A, v) \tag{14}$$

Where $g(.)$ is increasing in b (reserve wage effect) and t (tax effect), and decreasing A.

3.4. Indirect effect(E_{IND})

If productivity A is distributed according to a probability density function $f(A)$[1], then:

$$u^* = \int_0^{w^*} f(A)\, dA \tag{15}$$

The derivative of u^* with respect to b defines the indirect effect (E_{IND}):

$$E_{IND} = \frac{\partial u^*}{\partial b} = f(w^*) \times \frac{\partial w^*}{\partial b} \tag{16}$$

Sine $\frac{\partial w^*}{\partial b} > 0$, the sign of E_{IND} depends on the density function $f(w^*)$. If $E_{IND} > 0$, unemployment insurance increases structural unemployment; if $E_{IND} < 0$, it improves labour market matching and reduces unemployment.

Unemployment insurance therefore operates through two complementary mechanisms. The direct effect (E_D) that protects individuals against uncertainty. But it may prolong the duration of unemployment by raising the reservation wage. The indirect effect (E_{IND}) in its turn, influences the labour market equilibrium depending on the distribution of productivity and firm financing (Lerche, 2025). The overall balance depends on a comparison of these two effects: $E_D \gtrless | E_{IND} |$.

When social protection outweighs distortions ($E_D > | E_{IND} |$), the overall effect is positive; otherwise ($E_D < | E_{IND} |$), the overall effect is negative. This condition formalises the trade-off between social protection and economic efficiency.

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[1] Indeed, productivity A is a continuous random variable, represented by a probability density function $f(A)$. The equilibrium unemployment rate can then be expressed as an integral of this density, which allows us to analytically derive the indirect effect of unemployment insurance. With a discrete distribution, the analysis would be similar but based on sums rather than integrals. A sum would then be used: $u^* = \sum_{A \le w^*} \Pr(A)$

4. Analysis and discussions

4.1. Direct effects (E_D)

From equation (5), the reservation wage is given by:

$$w^* = \left(\frac{b^\alpha v^{1-\alpha}}{(v-\delta)^{1-\alpha}} \right)^{1/\alpha} \tag{17}$$

Differentiation with respect to b yields:

$$\frac{\partial w^*}{\partial b} = \frac{1}{\alpha} \left(\frac{v}{v-\delta} \right)^{1-\alpha} \times b^{1/\alpha - 1} > 0 \tag{18}$$

This result shows that any increase in the benefit b raises the reservation wage. The effect is all the more pronounced when the preference for leisure v is high. From a theoretical perspective, this confirms the intuition of Knight (1921), according to which unemployment insurance reduces uncertainty by transforming a random period into guaranteed income. It also echoes the criticism of Allais (1953), who points out that some individuals prioritize income stability over a quick return to employment. The E_D is therefore ambivalent. It protects against uncertainty but may prolong the duration of unemployment for certain profiles.

4.2. Indirect effects (E_{IND})

The equilibrium unemployment rate is defined as:

$$u^* = \Pr(w^* > A) \tag{19}$$

Replacing w^*,we obtain:

$$u^* = \Pr\left(\left(\frac{b^\alpha v^{1-\alpha}}{(v-\delta)^{1-\alpha}} \right)^{\frac{1}{\alpha}} > A \right) \tag{20}$$

The derivative with respect to b gives:

$$\frac{\partial u^*}{\partial b} = f(w^*) \times \frac{\partial w^*}{\partial b} \tag{21}$$

Where $f(A)$ is the density of the productivity distribution.

The indirect effect depends on the configuration of the labour market.

When productivity is low, an increase in b excludes more individuals and increases structural unemployment ($E_{IND} > 0$). Conversely, if the distribution of A is wide and wages are high, the effect may be mitigated or reversed ($E_{IND} < 0$). In this case, unemployment insurance facilitates matching by allowing individuals to wait for a more suitable job. This logic echoes Borch (1968, 1990), who views insurance as an implicit contract. Also, it protects but may create moral hazard if it is too generous. These results are also in line with Kouakou's (2025) ideas on parasites in growth and AI models.

4.3. Discussions

The combination of the two effects leads to the following equilibrium condition: $E_D \gtrless | E_{IND} |$.

When the direct effect is greater than the indirect effect, unemployment insurance has an overall positive effect, because the protection against uncertainty outweighs the distortions. Conversely, the overall effect is negative, as distortions outweigh protection. Comparative statics make it possible to clarify these results. E_D increases with the level of the benefit b and the preference for leisure v, while E_{IND} increases with b and the tax t, but decreases with productivity A. Thus, in a productive market with moderate benefits, E_D tends to dominate, leading to an overall positive effect. In contrast, in a low-productivity market with generous

benefits, E_{IND} dominates and the overall effect becomes negative. This logic is consistent with growth and innovation models (Zeira, 1998; Aghion et al., 2017), which emphasize the importance of simultaneously evaluating direct and indirect effects in order not to under- or overestimate the impact of a policy.

Our model shows that unemployment insurance serves several functions. It is a tool for managing individual risk, as Knight pointed out. It generates heterogeneous risk-taking behaviour, as Allais demonstrated. It is also a collective contract subject to equilibrium constraints, according to Borch.

Unemployment insurance can prolong unemployment. This occurs through an increase in the reservation wage (E_D). It can also improve matching. It can create distortions depending on the market configuration (E_{IND}). Thus, reforms must adjust the level of benefits. They must introduce conditional mechanisms to limit moral hazard. They must take into account the structure of the labour market to reduce distortions.

5. Concluding remarks

This article has examined unemployment insurance in situations of uncertainty by developing a theoretical model of risks and incentives. The analysis has showed how unemployment benefits affect the duration of unemployment through their direct impact on individual behaviour and their indirect impact on labour market equilibrium. Our theoretical framework combines two complementary traditions. Growth and automation models (Zeira, 1998; Aghion et al., 2017) emphasise the importance of assessing direct and indirect effects simultaneously, while risk and insurance theory (Knight, 1921; Allais, 1953; Borch, 1968, 1990) highlights the distinction between risk and uncertainty, heterogeneous reactions to risk, and the logic of mutualisation and incentives. By reconciling these perspectives, our hybrid approach provides a unified framework for studying unemployment insurance. In comparison with existing models such as Albrecht and Axell (1984), Eckstein and Wolpin (1990), and Schmieder and Von Wachter (2016), our contribution lies in formalising the compromise between protection and distortion through the condition $E_D \gtrless | E_{IND} |$. This positioning clarifies how our model extends micro-level analyses of reservation wages and empirical studies of unemployment duration by embedding them in a broader equilibrium framework.

The main results indicate that unemployment insurance has a direct effect by increasing the reservation wage, which can prolong unemployment, particularly among individuals who value leisure time. It also has an indirect effect by altering the balance of the labour market through financing by companies and incentives to hire. Depending on the distribution of productivity, this effect can either increase structural unemployment or improve the matching between jobs and workers. The overall impact results from the comparison between these two channels. If the protection offered outweighs the distortions it generates, collective well-being improves; otherwise, unemployment may rise and labour market efficiency may suffer.

These findings carry significant economic policy implications. Policymakers must design unemployment insurance systems that balance protection and incentives. This involves adjusting the level of benefits according to individual preferences; introducing conditional mechanisms to limit moral hazard, and accounting for the structure of the labour market to reduce distortions. In developing countries, particularly in Africa, unemployment insurance can play a stabilising role, but it must be inclusive and adapted to local socio-economic contexts. Reforms should therefore not only focus on the generosity of benefits but also on their conditionality, the financing mechanisms, and their interaction with productivity levels. The

study nevertheless has limitations. The framework is theoretical and does not use empirical data to validate the hypotheses. It does not incorporate economic cycle dynamics or interactions with other social policies such as training, mobility, or taxation. The utility function is simplified and could be enriched by more refined behavioural approaches. These constraints open avenues for future research: developing microeconomic models that capture evolving behaviours of individuals and firms, empirically testing the hypotheses with national or international data, and studying the links between unemployment insurance and other social protections. Extending the analysis to general equilibrium or neo-Keynesian frameworks would also allow for a better formalisation of the allocation of savings to investment and the effects of financial constraints on the labour market.

This article enriches our understanding of unemployment insurance in a context of uncertainty, showing that it combines risk management with potentially contradictory incentives. The reform of unemployment insurance systems must be based on this dual logic in order to reconcile social protection and economic performance.

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