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ÉCOLE POLYTECHNIQUE



CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

ON THE PROVISION OF INSURANCE AGAINST
SEARCH-INDUCED WAGE FLUCTUATIONS

Jean-Baptiste MICHAU

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DEPARTEMENT D'ECONOMIE

Route de Saclay

91128 PALAISEAU CEDEX

(33) 1 69333033

<http://www.economie.polytechnique.edu/>

<mailto:chantal.poujouly@polytechnique.edu>

On the Provision of Insurance Against Search-Induced Wage Fluctuations

Jean-Baptiste Michau*

Ecole Polytechnique

May 2013

Abstract

This paper investigates the provision of insurance to workers against search-induced wage fluctuations. I rely on numerical simulations of a model of on-the-job search and precautionary savings. The model is calibrated to low skilled workers in the U.S.. The extent of insurance is determined by the degree of progressivity of a non-linear transfer schedule. The fundamental trade-off is that a more generous provision of insurance reduces incentives to search for better paying jobs, which is detrimental to the production efficiency of the economy. I show that progressivity raises the search intensity of unemployed worker, which reduces the equilibrium rate of unemployment, but lowers the search intensity of employed job seekers, which results in a lower output level. I also solve numerically for the optimal non-linear transfer schedule. The optimal policy is to provide almost no insurance up to a monthly income level of \$1450, such as to preserve incentives to move up the wage ladder, and full insurance above \$1650. This policy halves the standard deviation of labor incomes, increases output by 2.4% and generates a consumption-equivalent welfare gain of 1.3%. Forbidding private savings does not fundamentally change the shape of the optimal transfer function, but tilts the optimal policy towards more insurance at the expense of production efficiency.

Keywords: Moral hazard on the job, Optimal social insurance, Progressivity, Search frictions

JEL Classification: H21, J38, J68

1 Introduction

The continuous reallocation of workers from low to high productivity jobs is an important source of production efficiency. However, at the individual level, this process generates

*Contact: Jean-Baptiste.Michau@polytechnique.edu

a substantial amount of wage fluctuation. This raises the following questions: Should workers be provided with insurance against these fluctuations? If so, how?

The crux of the problem is that, under a generous provision of insurance, a low wage worker has little incentives to move to a higher productivity job. Insurance against wage fluctuations therefore creates a moral hazard problem which is detrimental to the production efficiency of the economy.

The main contribution of this paper is to characterize the optimal provision of insurance against search-induced wage dispersion. The approach that I follow could be seen as a straightforward extension of the classical unemployment insurance problem. Indeed, the goal is to reduce fluctuations in labor income while the main impediment to the provision of insurance is a moral hazard effect which reduces the intensity of job search. The novelty is that, in my context, job search also occurs on the job.

My analysis of insurance against wage fluctuations relies on a model of on-the-job search. Both employed and unemployed workers choose a search intensity which determines the arrival rate of job offers. The corresponding wage rates are randomly drawn from an exogenous distribution. An employed worker only accepts an offer if it increases his wage rate. Hence, on-the-job search enhances the production efficiency of the economy by inducing workers to move up a "wage ladder". Any match can be hit by an exogenous job destruction shock which induces its worker to become unemployed. Individuals can accumulate some precautionary savings to self-insurance against unemployment as well as low wages realizations.

The insurance policy consists of a non-linear transfer schedule which determines the labor income of a worker at each rung of the wage ladder. A budget constraint imposes that the transfers must sum to zero. As it is not possible to characterize the optimal policy analytically, I rely on numerical simulations throughout the paper. The model is calibrated with PSID data to the U.S. economy. Importantly, insurance, unlike redistribution, can be conditioned on the education level of its beneficiaries without discouraging the accumulation of human capital. I therefore exclusively focus on the provision of insurance to low skilled workers, who have never been to college.

In my analysis, I analyze the provision of insurance from both positive and normative perspectives. From a positive perspective, I show that insurance against wage fluctuations increases the search intensity of unemployed workers which reduces the equilibrium rate of unemployment. This is due to the combination of two factors. First, as the distribution of actual wages first-order stochastically dominates the distribution of offered wages, under a balanced budget, the insurance raises the average level of offered wages. Second, a reduction in the dispersion of offered wages enhances the attractiveness of being employed. However, the provision of insurance through the implementation of a progressive transfer schedule reduces the intensity of on-the-job search. This latter effect dominates which

explains why progressivity reduces the output level of the economy.

From a normative perspective, my main contribution is to characterize numerically the optimal non-linear transfer schedule. The optimal policy consists in providing almost no insurance to the lower half of the wage distribution, below \$1450 per month, and full insurance above \$1650. This is a consequence of the fact that, in the absence of insurance, on-the-job search is strong among low wage workers and very weak among high wage workers who are unlikely to find better paying jobs. Thus, the moral hazard problem of insurance is concentrated towards the bottom of the wage distribution and it is absent from the top. The elimination of labor income dispersion among workers earning more than \$1650 increases the search intensity of the unemployed and of low wage workers. Thus, not only does the optimal insurance policy reduce fluctuations in labor incomes, it also enhances production efficiency which raises output by 2.4%. The implementation of this policy generates a consumption-equivalent welfare gain of about 1.3%. Finally, the absence of private savings does not fundamentally alter these results, but tilts the optimal policy towards more insurance at the expense of production efficiency.

Related Literature. My paper is related to a substantial literature in public finance which investigates the provision of insurance against income fluctuations. However, none of these papers, except for one important exception (Golosov, Maziero and Menzio 2012), allow for search frictions as a source of income uncertainty.¹ This is rather paradoxical given the central importance of search frictions within the empirical literature on wage fluctuations. I now briefly review these different strands of the literature.

Varian (1980) argued that the income of a worker is not only determined by ability at birth but also, to an even greater extent, by luck. Based on this observation, he emphasized that a progressive income tax *de facto* provides insurance against fluctuations in labor income. He then characterized the optimal social insurance policy in a stylized two period model. Eaton and Rosen (1980), Diamond, Helms and Mirrlees (1980) and Mirrlees (1990) made similar contributions, all focusing on linear tax schedules in uncertain environments where the provision of insurance reduces labor supply.

Following the key contribution of Golosov, Kocherlakota and Tsyvinski (2003), a sizeable literature has emerged on the optimal design of insurance against hidden shocks to productivity.² In that framework, the labor market is competitive and the main impediment to the provision of insurance is a large set of incentive compatibility constraints which ensure that workers do not claim to be less productive than they truly are. Given the complexity of the problem, the optimal policy could only be fully characterized in

¹Hungerbühler, Lehmann, Parmentier and van der Linden (2006) and Schaal and Taschereau-Dumouchel (2010) characterized the optimal redistribution policy in search models of the labor market. However, these papers focus on redistribution across workers of different productivities, not on insurance against wage fluctuations.

²Kocherlakota (2010) offers an extensive survey of this New Dynamic Public Finance literature.

special cases. Albanesi and Sleet (2006) solved the optimal social insurance problem when productivity shocks, and hence wages, are independently and identically distributed. More recently, Farhi and Werning (2013) managed to solve the AR(1) case.

My paper adopts a complementary perspective on the provision of insurance against wage fluctuations. Indeed, this literature focuses on the extent to which insurance against exogenous changes in the wage rate affects labor supply along the intensive margin. By contrast, I assume that changes in the wage rate are caused by search frictions and I focus on the extent to which insurance discourages workers from moving to higher productivity jobs.³

As an alternative to solving complex mechanism design problems, a number of authors have chosen to rely on stochastic macroeconomic models with heterogeneous agents in order to investigate numerically the optimal design of social insurance. Importantly, in these papers, the shape of the labor income tax simultaneously affects both redistribution and social insurance. More specifically, Floden and Lindé (2001) restricted their attention to linear taxes on labor income used to finance lump sum transfers. They found that, in the U.S., raising the tax rate from 36.1% to the optimal level of 46% generates a consumption-equivalent welfare gain of 1.8%. Moving one step further, Conesa and Krueger (2006) determined the optimal non-linear taxation of labor income within a flexible three-parameter family of tax functions. They found that the optimal policy in the U.S., which yields a welfare gain of 1.7%, is well approximated by a flat tax rate of 17.2% together with a deduction of \$9400 (per annum). Karabarbounis (2012) investigated the extent to which optimal non-linear labor income taxes should be differentiated across both age and wealth groups. He found that tax rates should be decreased for workers who are older than 50, especially if they are wealthy, such as to induce them to have long careers. Implementing the optimal policy generates a welfare gain of 0.85%.

These numerical papers simultaneously investigate the impact of progressive income taxation on both redistribution and social insurance. However, as mentioned above, social insurance, unlike redistribution, can be conditioned on the education level of its beneficiaries as the provision of insurance does not reduce incentives to invest in human capital. Hence, in this paper, I abstract from redistribution across *ex-ante* heterogeneous workers and focus exclusively on the provision of insurance to low skilled workers.⁴

While none of the aforementioned papers allow for search frictions, Golosov, Maziero and Menzio (2012) characterized analytically the optimal provision of insurance in a directed search model of the labor market with homogenous workers and heterogeneous firms. They found that the optimal policy consists in implementing an increasing and

³Another difference is that, while the New Dynamic Public Finance literature manages to characterize second-best policies, I restrict my attention to simple history-independent policies.

⁴My analysis abstracts from productivity differences across low skilled workers due to unobserved heterogeneity.

regressive labor income tax which increases the fraction of unemployed workers who direct their search towards high productivity jobs. Importantly, the directed nature of search implies that, *ex-ante*, all workers always get the same utility, i.e. a worker only gets a high wage if he is willing to face a long queue. Hence, the optimal regressive income tax is a Pigovian tax that corrects for externalities.

My paper follows an alternative and complementary approach to search frictions. I assume random search on and off the job, instead of directed search off the job. Hence, wage dispersion is due to luck on the labor market. The provision of insurance is justified, not to redirect the search effort of unemployed workers from low to high productivity jobs, but to attenuate the effect of luck on wage dispersion. However, as we shall see, I also find that some regressivity is desirable in order to enhance workers' incentives to search for high productivity jobs.⁵

The labor market impact of income tax progressivity has also been analyzed by Pissarides (1983) and Ljungqvist and Sargent (1995) who, however, did not focus on the provision of insurance against wage dispersion. Both emphasized that the implementation of progressive labor income taxes can reduce the equilibrium rate of unemployment. While I obtain the same result, the underlying mechanism is somewhat different. They argued that progressivity reduces the reservation wage below which a worker refuses an offer or decides to quit his job. By contrast, in my model which allows for on-the-job search, workers always prefer to be employed rather than unemployed. They therefore accept all offers. Instead, progressivity reduces unemployment by raising the search intensity of unemployed workers. Interestingly, Ljungqvist and Sargent (1995) also found that the reduction in unemployment due to progressivity comes at the cost of a decline in the production efficiency of the economy.

As mentioned above, my paper could be seen as a straightforward extension of the classical unemployment insurance problem where the moral-hazard problem extends to on-the-job search. Thus, Hansen and Imrohorglu (1992) and Lentz (2009), which both solved numerically for the optimal level of unemployment benefits in the presence of private savings, are two closely related contributions.

Finally, a number of papers of the macro-labor literature have recently emphasized the importance of search frictions to account for the dynamics of wage fluctuations. Low, Meghir and Pistaferri (2010) performed an empirical decomposition of wage fluctuations into permanent individual-specific productivity shocks and match-specific shocks. They found that the standard deviation of the match-specific shocks is more than twice as large as that of the permanent shocks. The match-specific shocks are nevertheless less

⁵In my paper, regressivity induces low wage workers to search more intensively for high productivity jobs; while, in Golosov, Maziero and Menzio (2012), regressivity induces a larger fraction of unemployed workers to direct their search towards high productivity jobs.

persistent over the life-cycle. Altonji, Smith and Vidangos (2013) found that job mobility and unemployment account for 43.0% of the variance in lifetime earnings and 53.2% of the variance in wages, while education account for about 30% of the variance in both lifetime earnings and wages. These two empirical studies confirm that job mobility is a major source of wage changes.

Lise (2013) argued that the dynamics of the wage ladder are a primary determinant of the precautionary savings behavior of individuals. Relying on simulations of a structurally estimated model of the wage ladder, he showed that the model generates distributions of earnings, wealth and consumption which almost perfectly match their empirical counterparts. Lentz and Mortensen (2010) concluded from their survey of the literature that firm heterogeneity, rather than worker heterogeneity, is the main explanation of productivity differences across workers and that the reallocation of workers from low to high wage employers is a major source of productivity gains. Gentry and Hubbard (2004) estimated that, in the U.S., a five percentage point decrease in the marginal tax rate raises turnover by 8%. This confirms the importance of moral hazard on the job. Finally, Hagedorn and Manovskii (2013) recently provided some empirical evidence that wages are primarily determined by match quality. This provides additional support for my model of the wage ladder which does not allow for strategic bargaining or counter-offers between a worker and his employer.

The paper is organized as follows. Section 2 presents the theoretical model on which I rely throughout my analysis. Section 3 is devoted to the calibration of the model. In Section 4, I describe a benchmark simulation of the model. The policy analysis is performed in Section 5. Section 6 investigates the policy consequences of not allowing for private savings. The paper ends with a conclusion.

2 Model

Time is discrete and the horizon is infinite. In each time period, a worker can either be employed or unemployed. Workers are risk averse and derive an instantaneous utility $v(c)$ from consuming c in a given period, where $v'(\cdot) > 0$ and $v''(\cdot) < 0$. They discount the future at rate ρ .

In each period, an unemployed worker gets income b and needs to incur a cost $D_u(s_u)$ in order to receive a job offer with probability s_u , where $D'_u(\cdot) > 0$ and $D''_u(\cdot) > 0$. If he receives an offer, the corresponding wage rate w is randomly drawn from an exogenous wage offer distribution with c.d.f. $F(w)$, p.d.f. $f(w)$ and support $[\underline{w}, \bar{w}]$. An unemployed worker only chooses to accept an offer if the corresponding wage rate w is above a threshold R , which occurs with probability $1 - F(R)$.

The dispersion among offered wages induces employed workers to continue searching

on the job in the hope of obtaining a more lucrative position. Thus, in each period, a worker employed at wage w receives his income w and incurs a cost $D(s)$ in order to get an offer with probability s , where $D'(\cdot) > 0$ and $D''(\cdot) > 0$. Wage offers are drawn from the same exogenous wage offer distribution $F(w)$.⁶ Any employed worker trivially chooses to accept the offer if the offered wage is above his current wage rate w , which occurs with probability $1 - F(w)$. At the end of any time period, all job matches face an exogenous probability δ of being hit by a job destruction shock.

For any given worker, the existence of search frictions generates a substantial amount of wage fluctuations over time. This should naturally induce them to accumulate some precautionary savings. I shall therefore assume that workers can buy any amount of a risk-free asset. However, they cannot borrow.⁷ The risk-free interest rate is denoted by r .

Finally, the insurance policy, which is the focus of this paper, raises the income of unemployed workers by z and reduces the income of workers employed at wage w by $T(w)$ (where $T(w)$ can be negative for some w). Thus, z determines the provision of insurance against unemployment and $T(\cdot)$ that of insurance against wage fluctuations.

Let $U(A)$ and $W(A, w)$ denote the expected utility of an unemployed worker with wealth A and of an employed worker with wage w and wealth A , respectively. The structure of the model implies that $U(A)$ can be written recursively as:

$$U(A) = \max_{\{c_u, s_u, R\}} v(c_u) - D_u(s_u) + \frac{1}{1 + \rho} \left[s_u \int_R^{\bar{w}} W(A', x) dF(x) + (1 - s_u [1 - F(R)]) U(A') \right] \quad (1)$$

subject to:

$$A' = (1 + r)A + b + z - c_u \text{ and } A' \geq 0, \quad (2)$$

where A' denotes next period's value of A . Similarly, $W(A, w)$ satisfies:

$$W(A, w) = \max_{\{c, s\}} v(c) - D(s) + \frac{1}{1 + \rho} \left[s \int_w^{\bar{w}} W(A', x) dF(x) + \delta U(A') + (1 - \delta - s [1 - F(w)]) W(A', w) \right] \quad (3)$$

subject to:

$$A' = (1 + r)A + w - T(w) - c \text{ and } A' \geq 0. \quad (4)$$

The solution to these optimization problems is characterized by the following policy

⁶The assumption of an exogenous wage offer distribution rules out any general equilibrium effect of the policy on the recruiting behavior of firms. There is however no simple and realistic way of endogenizing this distribution. Moreover, general equilibrium effects are not relevant if, initially, the insurance policy is only offered to a small fraction of low skilled workers.

⁷Alternatively, I could impose the natural borrowing limit. However, it is not clear that, in practice, unemployed workers could be forced to use their unemployment benefits to repay their debts.

functions: $c_u(A)$, $s_u(A)$, $R(A)$, $c(A, w)$, $s(A, w)$.

An unemployed worker with wealth A chooses to set his job acceptance threshold $R(A)$ such that $W(A', R(A)) = U(A')$ where $A' = (1 + r)A + b + z - c_u(A)$. Note that, if employed and unemployed workers face the same search costs, i.e. $D(\cdot) = D_u(\cdot)$, then $R(A)$ is determined by $R(A) - T(R(A)) = b + z$, which implies that the job acceptance threshold is independent of wealth, i.e. $R(A) = R$. Indeed, if $D(\cdot) = D_u(\cdot)$, then there is no option value (neither positive nor negative) of remaining unemployed. In that case, jobless workers are willing to accept an offer w provided that this raises their income, i.e. provided that $w - T(w) \geq b + z$.

Let $g(A, w)$ denote the joint p.d.f. of wealth and wages among employed workers in steady state. The support of this distribution is $[0, \bar{A}] \times [\underline{R}, \bar{w}]$, where \underline{R} is the lowest job acceptance threshold among the unemployed. It follows that the actual wage distribution is given by $g_w(w) = \int_0^{\bar{A}} g(A, w) dA$. Similarly, $g_u(A)$ denotes the wealth distribution among unemployed workers. Its support is $[0, \bar{A}]$. In steady state, the flow into the set of unemployed workers must be equal to the corresponding outflow. The rate u of unemployment must therefore satisfy:

$$\left(\int_0^{\bar{A}} s_u(A) [1 - F(R(A))] g_u(A) dA \right) u = \delta(1 - u). \quad (5)$$

Throughout my analysis, I impose that the insurance policy $\{z, T(\cdot)\}$ operates under a balanced budget.⁸ It must therefore satisfy:

$$uz = (1 - u) \int_{\underline{R}}^{\bar{w}} T(w) g_w(w) dw. \quad (6)$$

The objective of the planner is to maximize social welfare as measured by:

$$u \int_0^{\bar{A}} U(A) g_u(A) dA + (1 - u) \int_0^{\bar{A}} \int_{\underline{R}}^{\bar{w}} W(A, w) g(A, w) dw dA. \quad (7)$$

The optimal policy problem consists in determining z and $T(\cdot)$ such as to maximize social welfare (7) subject to the structure of the economy summarized by (1), (2), (3) and (4) and to the budget constraint (6). As this problem cannot be solved analytically, I rely on numerical simulations throughout my analysis.

⁸As explained in the following section, I calibrate $F(w)$ to the distribution of wages net of government taxes and transfers in order to focus on the desirability of an additional provision of insurance. However, the insurance policy modifies the rate of unemployment and the distribution of wages, which could affect government revenue. For simplicity and transparency, I am assuming that the provider of insurance, whether public or private, is not required to make a compensating transfer to the federal government. While it would be possible to relax this assumption, the magnitude of the transfers implied by the optimal policy would be very small and probably even negative.

The structure of my model is very close to that of Christensen, Lentz, Mortensen, Neumann and Werwatz (2005). There are however three key differences. First, I assume that workers are risk-averse, second, I do not impose that the cost of searching on the job is equal to that of searching while unemployed and, finally, I allow for private savings. Lise (2013) also studies a model of the wage ladder with risk-averse workers and private savings, but he assumes identical costs of searching on and off the job.

My model does not allow for an intensive margin of labor supply within a job. This is consistent with substantial empirical evidence showing that workers have a very limited ability to adjust their hours of work within a job.⁹ However, an increase in the distribution of offered wages induces low wage workers to raise their search intensity which eventually results in higher paying jobs. Moreover, the search intensity s could also capture the effort that a worker is willing to make on the job in the hope of getting promoted. Thus, my model does not prevent gross earnings from responding to changes in tax rates. It is therefore consistent with the observation of a positive intensive margin elasticity at the macro level.

Now that the theoretical model is fully specified, I turn to its calibration.

3 Calibration

I calibrate the model such that a time period corresponds to one month. Workers discount the future at 4% per year, i.e. $\rho = 0.04/12$. They have a CRRA utility function:

$$v(c) = \frac{c^{1-\theta} - 1}{1-\theta}, \quad (8)$$

where the coefficient θ of relative risk aversion is equal to 2. I assume that the real risk-free interest rate is equal to 1% per year, i.e. $r = 0.01/12$. In the benchmark calibration, this implies an average wealth to yearly GDP ratio equal to 1.32. While not very large, this number seems to be of a plausible magnitude for low skilled workers who are typically not very wealthy.

I then need to calibrate the exogenous wage offer distribution $f(w)$. My theoretical framework implies that the wage offer distribution corresponds to the wage distribution among newly employed workers, provided that the unemployed's reservation thresholds $R(A)$ are sufficiently low. To uncover this distribution I rely on PSID data from 1997 to 2007. I focus on the heads of households and exclude workers younger than 25 or older than 60 years old, the self-employed and those who have been out of the labor force in the previous year. As I want to focus throughout this paper on the provision of insurance

⁹See, for instance, Altonji and Paxson (1992), Dickens and Lundberg (1993), Stewart and Swaffield (1997) or Chetty, Friedman, Olsen and Pistaferri (2011).

to low skilled workers, I restrict my sample to those who have never been to college.¹⁰ I can then easily obtain the monthly gross-income distribution among those who were unemployed in the previous year.

Note that the progressivity of the tax code already offers some insurance against wage fluctuations. In this paper, I want to investigate the welfare consequences of providing additional (educational-level specific) insurance against wage fluctuations. Hence, $f(w)$ must correspond to the distribution of net-income among newly employed workers. I therefore rely on the NBER microsimulation device TAXSIM in order to obtain the net monthly salary for all the 577 workers of my sample. To compute the workers' tax liability with TAXSIM, I assume for simplicity that they do not receive any income other than their salary and that they are all single.¹¹ The corresponding empirical wage offer distribution is plotted in Figure 1. Rather than calibrate my model with the somewhat noisy empirical wage offer distribution, I use the smooth lognormal distribution of Figure 1. The lower bound of this distribution is \$600, its mean is \$1614 and its standard deviation is \$646.¹²

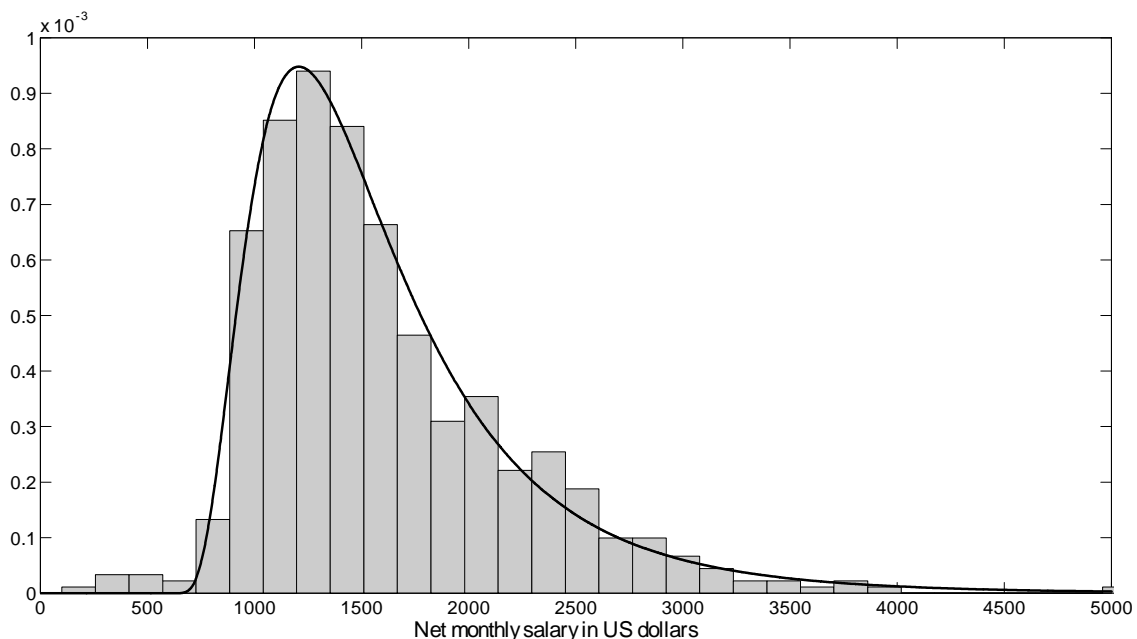


Figure 1: Wage Offer Distribution

A possible concern with the proposed calibration strategy is that it fails to account

¹⁰Note that, in the context of redistribution, it is not desirable to condition taxes on the level of education as this would induce agents to under-invest in human capital accumulation. By contrast, I focus here on a pure social insurance problem. Hence, conditioning the provision of insurance on education, or on any other proxy for the wage offer distribution facing the individual, has no adverse behavioral consequences.

¹¹Allowing for marriage, which is an important source of insurance for many individuals, would clearly reduce the welfare gains generated by the insurance policy under investigation. However, the analysis of marriage is beyond the scope of my paper which therefore focuses on single individuals.

¹²In the empirical distribution, only 5 workers out of 577 earn less than \$600 per month. The mean and standard deviations of the empirical distribution are \$1590 and \$599, respectively.

for the fact that some low-paying job offers might be rejected by unemployed workers who have a high reservation threshold $R(A)$. This would induce low wage offers to be under-represented in Figure 1. In my sample, 63.8% of unemployed workers do not receive any income from unemployment compensation.¹³ These workers presumably have lower reservation thresholds than those who do receive some unemployment benefits. The average compensation among recipients between 2002 and 2006 is \$1058. If we focus on low salaries, i.e. below \$1600, we find that the average earnings of those who are eligible and of those who are not is approximately the same, it is equal to \$1227 and \$1210, respectively.¹⁴ This suggests that workers who do not receive unemployment compensation are not more likely to accept low offers and, hence, that the selection bias underlying the construction of Figure 1 is not too severe. Moreover, the distribution of wage offers of Figure 1 already includes a high mass of very low offers (with nearly a third of offers below \$1250). As we shall see, the benchmark calibration implies that unemployed workers accept all job offers.

I calibrate the exogenous monthly job destruction probability δ such that the equilibrium rate of unemployment is equal to 5%. As I subsequently calibrate the search cost function of the unemployed $D_u(\cdot)$ such that the monthly job finding probability is equal to $1/3$, the steady state condition for unemployment (5) immediately implies that $\delta = (0.05/3)/(1 - 0.05) \simeq 0.0175$. It follows that the expected match length for workers at the top of the wage distribution who are not searching on the job, i.e. the maximal expected match length in the economy, is equal to $1/\delta = 57$ months, i.e. 4 years and 9 months.

Only 36.2% of unemployed workers receive some unemployment compensation. Between 2002 and 2006, these workers received on average \$1058. I therefore set the level of unemployment benefits b to \$383. Setting it to \$1058 for all workers would fail to recognize that raising the average generosity of unemployment benefits requires raising taxes to finance them. Hence, it is important to allow for the fact that increasing the generosity of unemployment benefits, by setting $z > 0$, requires raising some revenue through $T(\cdot)$ such to satisfy the budget constraint (6).

Finally, I need to calibrate the search cost functions $D_u(\cdot)$ and $D(\cdot)$. I assume that

¹³This is either due to incomplete take-up (cf. Currie 2004) or to ineligibility. Ineligibility could result from temporary work, part-time employment, benefits exhaustion beyond 26 weeks, insufficient past employment experience or quits.

¹⁴On average, across the whole distribution, eligible workers have a salary of \$1750 while ineligible workers earn \$1498. However, this difference is *not* due to a different rejection rate of low offers among those whose reservation threshold is below \$1600. As \$1600 seems to be a high threshold for this population, this suggests that the difference in average earnings is primarily due to different characteristics of workers across the two groups which leads to different distribution of offers being received above \$1600.

they are both given by a power function:

$$D_u(s_u) = k_u \frac{s_u^{\gamma_u}}{\gamma_u} \text{ and } D(s) = k \frac{s^\gamma}{\gamma}. \quad (9)$$

I calibrate k_u such that the monthly job finding probability is equal to $1/3$. The curvature parameter γ_u is set such that the elasticity of the unemployment duration with respect to the generosity of unemployment benefits b is equal to 0.5, consistently with the empirical evidence surveyed by Krueger and Meyer (2002).

The main impediment to the provision of insurance against wage fluctuations is that it reduces on-the-job search and, hence, the reallocation of workers to better paying jobs. The calibration of the cost of on-the-job search is therefore critical to my numerical exercise. For this, I rely on empirical evidence provided by Gentry and Hubbard (2004). Relying on PSID data from 1979 to 1993, they estimated that workers face a 0.0987 annual probability of moving to better jobs.¹⁵ I therefore calibrate k such that the monthly transition probability is equal to $1 - (1 - 0.0987)^{\frac{1}{12}} \simeq 0.0086$. This implies that the job-to-job transition flow is 49% as large as the job destruction flow (since $\delta = 0.0175$).

Finally, to calibrate γ , I use the fact that, according to Gentry and Hubbard (2004), a 5% increase in the marginal tax rate decreases the probability of job turnover by 0.0079, i.e. by 8%. Note that, assuming that workers face a marginal tax rate of¹⁶ 37%, a 5% increase in their marginal tax rate is equivalent to a 7.94% marginal tax on their net earnings (since $1 - 0.37 - 0.05 = (1 - 0.37)(1 - 0.0794)$). I therefore calibrate γ such that imposing a 7.94% tax rate on net earnings (while rebating the proceeds lump sum to all the workers such as to avoid, on average, creating an income effect) decreases the monthly probability of turnover to $1 - (1 - (0.0987 - 0.0079))^{\frac{1}{12}} \simeq 0.0079$.

To perform this calibration and to subsequently investigate the insurance policy, I rely on numerical simulations of the model. I implement the Howard improvement algorithm to characterize the value functions, the policy functions and the corresponding distribution of wealth and wages. I assume a discrete wage offer distribution with support $\{\$650, \$750, \$850, \dots, \$4950\}$. The wage ladder therefore contains 44 rungs. I discretize the wealth distribution into 41 grid points between \$0 and \$300 000 and allow for 600 interpolations between any two grid points. This implies that, for any agent, the smallest unit of savings is equal $(30000/40)/600 = \$12.5$. The dimension of the state is $41 \cdot 45 = 1845$ (since there are 41 wealth states and 45 labor market states corresponding to the 44 wage rungs and to unemployment). The Howard improvement algorithm cannot handle a much

¹⁵These moves could correspond to promotions and do not necessarily involve a change in employer. However, in my model, the search intensity of employed job seekers could be interpreted as including the effort that workers make in the hope of getting promoted.

¹⁶In my PSID sample, 37% is the average marginal tax rate faced by all the workers (including those who were not unemployed in the previous year).

larger dimension of the state since it requires inverting a transition matrix of dimension 1845×1845 . However, the steady state wealth and wage distributions $g(A, w)$ and $g_u(A)$ can be directly obtained from this transition matrix, which yields almost perfect accuracy.

The parameters generated by the calibration are summarized in Table 1.¹⁷

Parameter	Value	Target
ρ	0.04/12	.
r	0.01/12	Wealth to yearly output ratio equal to 1.32
θ	2	.
δ	0.0175	5% unemployment rate
$f(\cdot)$	Lognormal	PSID data
b	\$ 383	PSID data
ku	0.0097	Monthly job finding probability equal to 1/3
γu	1.0855	Elasticity of unemployment duration with respect to benefits equal to 0.5
k	0.0067	Monthly job-to-job transition probability equal to 0.0086
γ	1.1245	Elasticity of turnover with respect to marginal tax rate from Gentry Hubbard 2004

Table 1: Parameter Values

The calibration implies that the search cost functions are close to being linear.¹⁸ Moreover, searching for a job is always less costly while employed than while unemployed. Even though the job-to-job transition flow is only half as large as the job destruction flow, the cost of on-the-job search needs to be very low in order to induce workers who already have a job to search for a better one. As employment decreases the cost of searching for a job, unemployed workers are willing to accept all the offers that they receive. This implies that, at least in theory, the wage offer distribution $f(\cdot)$ and the wage distribution among newly employed workers, which was used to produce Figure 1, are identical.

4 Simulation

Before investigating the insurance policy, I briefly review the main features of the steady state equilibrium of the model. Figure 2 displays the simulated wage distribution (the

¹⁷An alternative strategy would have been to rely on a structural estimation of the model. However, to the extent that the model is a simplified representation of reality, rather than forcing the model to fit some micro-data, it seems more sensible to calibrate the model to ensure that the behavioral elasticities are of a plausible magnitude.

¹⁸Note that Lise (2013), who performed a structural estimation of a similar model with a single cost function for both employed and unemployed workers, found a similar degree of curvature of the search cost function (he found a curvature parameter of 1.168 among low skilled workers).

thick line), the offer distribution (the dotted line) together with the empirical wage distribution across all employed low skilled worker in the aforementioned PSID data set from 1997 to 2007. In the simulation, the average wage is equal to \$1935 and the corresponding standard deviation is \$600. In the data, the mean is \$2034 and the standard deviation is \$779. Given the stylized nature of the model (which was not calibrated to match the wage distribution), the simulation provides a reasonable fit to the data and manages to explain the bulk of wage dispersion observed in the PSID sample. Importantly, the model predicts that, on average, workers who lose their job will suffer from a wage cut of $(1935 - 1614)/1935 = 16.6\%$ upon re-employment.¹⁹

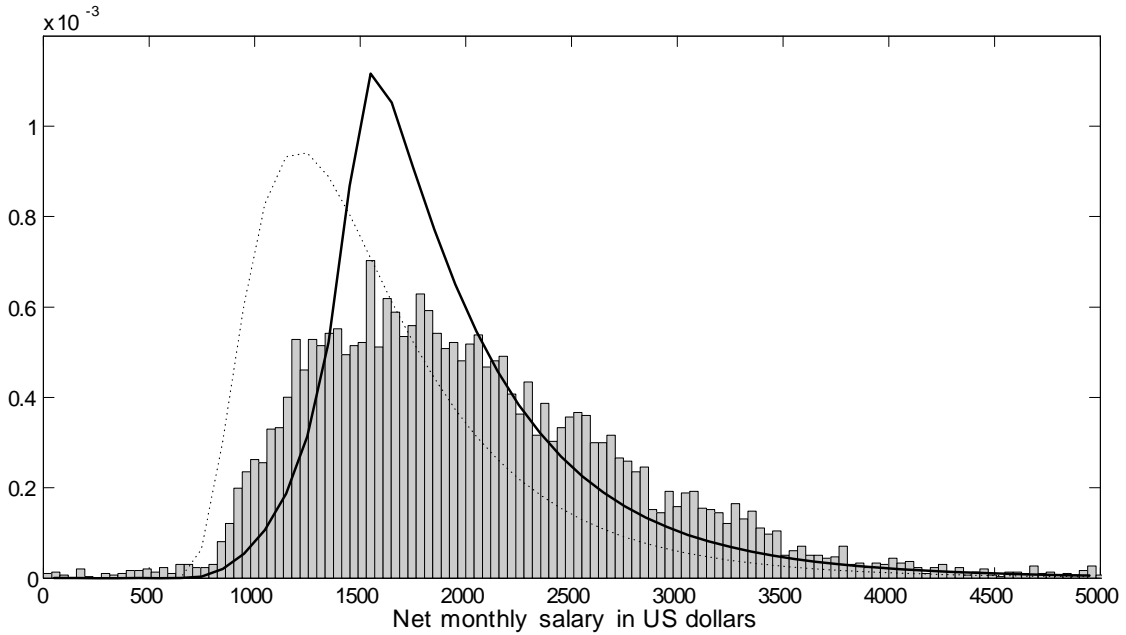


Figure 2: Wage Distribution

The average wealth of an agent amounts to \$29 191. The standard deviation of the wealth distribution is \$34 952. Also, less than 6.6% of the population holds no wealth. Interestingly, the average wealth of an unemployed worker is equal to \$49 847 while that of an employed worker is \$28 104. To understand this phenomenon, recall that all workers are equally likely to become unemployed in any given month. Thus, the average wealth of newly unemployed workers is \$28 104. However, once unemployed, the search intensity of wealth-rich individuals is much lower than that of wealth-poor individuals. Hence, the duration of unemployment is much larger among the rich than among the poor. This composition effect explains why, on average, the unemployed are richer than the employed.

¹⁹The empirical distribution of wages and offered wages from the PSID sample suggests an average wage cut of $(2034 - 1590)/2034 = 21.8\%$ upon re-employment. Of course, the actual empirical average magnitude of wage loss upon re-employment is different if the model is not correctly specified, e.g. if all workers are not all equally likely to lose their job in a given month.

Figure 3 displays the average search intensity of employed workers for each wage level. The dot on the left indicates the average search intensity of unemployed workers. Clearly, workers who earn more than \$1500 are hardly searching on the job. This implies that the moral hazard impact of any additional provision of insurance will be most pronounced at the bottom of the wage distribution.

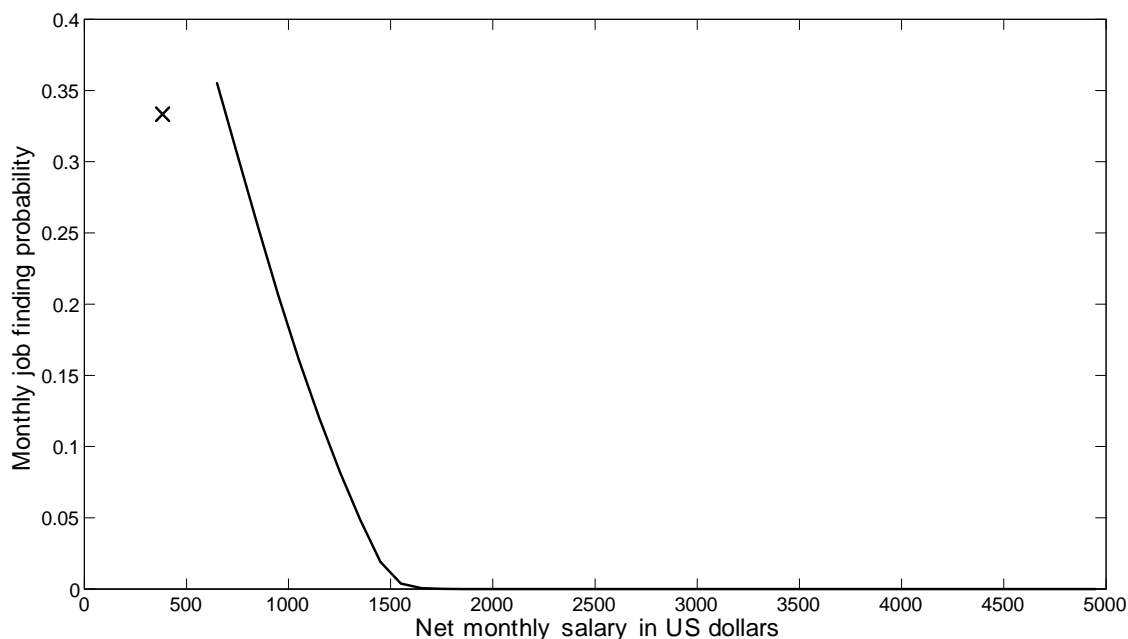


Figure 3: Search intensity

Finally, Figure 4 displays the average consumption level for each wage level. The dot on the left indicates the average consumption level of the unemployed, who are on average richer than the rest of the population. The dotted line corresponds to the 45 degree line, which would give the relationship between the wage rate and consumption in the absence of savings. This figure reveals that agents manage to considerably reduce fluctuations in consumption by accumulating some precautionary savings. They nevertheless have a limited ability to smooth high wage shocks. This is explained by the dynamics of the wage ladder which imply that high wage shocks are very persistent. Indeed, they last until the workers become unemployed. Perhaps surprisingly, workers with very low salaries have a higher consumption level than workers earning \$1500. This is due to the fact that workers with bad jobs are searching actively for better opportunities and are therefore expecting to earn more than \$1500 in the future, while workers earning \$1500 are likely to remain at this rung of the wage ladder until they become unemployed.

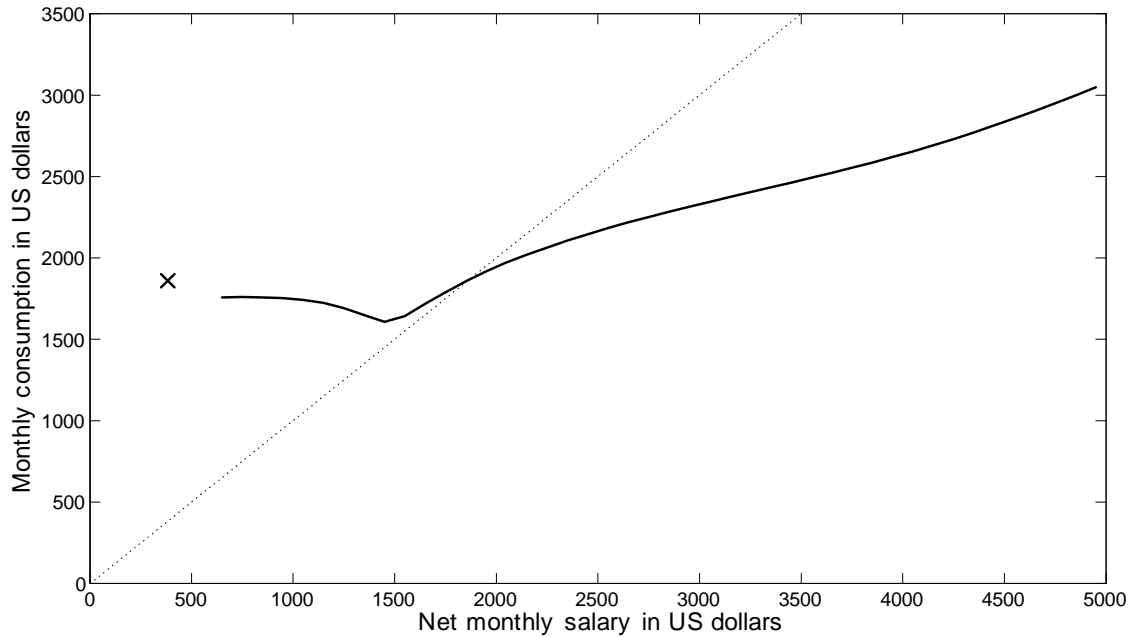


Figure 4: Consumption

5 Policy Analysis

Let us now investigate the impact of an enhanced provision of insurance on the equilibrium of the economy. For most of the analysis, I will set z equal to 0 in order to focus on the provision of insurance against wage fluctuations rather than on insurance against unemployment. The extent of insurance against wage fluctuations is determined by the shape of the transfer function $T(\cdot)$ and, more specifically, by its degree of progressivity. Indeed, if $T(\cdot)$ is linear, i.e. $T(w) = \alpha w$, then the budget constraint (6) imposes that it must be equal to zero, i.e. $\alpha = 0$. By contrast, if $T(\cdot)$ is progressive, i.e. $T(w)/w$ increasing in w , then, under a balanced budget, the transfer increases the labor income of low-wage employees, i.e. $w - T(w) > w$ for a low w , and decreases the labor income of high-wage employees, i.e. $w - T(w) < w$ for a high w .

In this section, I first conduct a positive analysis of the effect of progressivity on the equilibrium of the economy. This highlights the main trade-offs generated by the provision of insurance against wage fluctuations. In a second subsection, I numerically solve for the optimal non-linear insurance schedule $T(\cdot)$.

5.1 Impact of Progressivity

To investigate the economic effects of progressivity, I focus on the following family of transfer functions which has recently been used by Heathcote, Storesletten and Violante

(2012) and Karabarbounis (2012):

$$T(w) = w - \alpha w^{1-\tau}. \quad (10)$$

The labor income of a worker employed at wage w is therefore equal to $w - T(w) = \alpha w^{1-\tau}$. This functional form is convenient for my analysis as a single parameter, τ , captures the degree of progressivity of the insurance policy. The other parameter, α , is set such as to balance the budget constraint (6). Note that the size of the transfer is always equal to zero at the wage rate $\tilde{w} = \alpha^{1/\tau}$. The insurance policy therefore generates a transfer from workers with $w > \tilde{w}$ to those with $w < \tilde{w}$.

When $\tau = 0$, there is no provision of insurance, i.e. $\alpha = 1$ and $T(w) = 0$, and we are back to the benchmark case of the previous section. When $\tau = 1$, there is full provision of insurance as workers' net income is independent of their wage rates, i.e. $w - T(w) = \alpha$. Hence, there is no incentives to search on the job which implies that the distributions of actual and offered wages coincide. The income of all workers is therefore equal to the mean of the distribution of wage offers, i.e. $\alpha = \$1603$.²⁰

I now simulate the model for intermediate values of τ . Figure 5 displays the distributions of wages, i.e. of w , and of labor incomes, i.e. of $w - T(w)$, for τ equal to 0, 0.5 and to 1. When $\tau = 0$, the wage and income distributions coincide and are given by the thin dashed line. When $\tau = 0.5$, the wage distribution is given by the bold dashed line while the labor income distribution is given by the bold solid line. Clearly, the progressivity of the insurance policy reduces the dispersion of labor incomes. However, raising τ from 0 to 0.5 reduces incentives to search on the job which results in a downward shift of the wage distribution. Finally, when $\tau = 1$, there is no on-the-job search. Hence, the wage distribution coincides with the offer distribution, given by the thin dotted line, while the income distribution is a mass point at $\$1603$, represented by a thin solid vertical line.

²⁰For the numerical simulations, I rely on a discrete wage offer distribution which has a mean, $\$1603$, which is slightly below the mean, $\$1614$, of the corresponding continuous distribution mentioned in the calibration section.

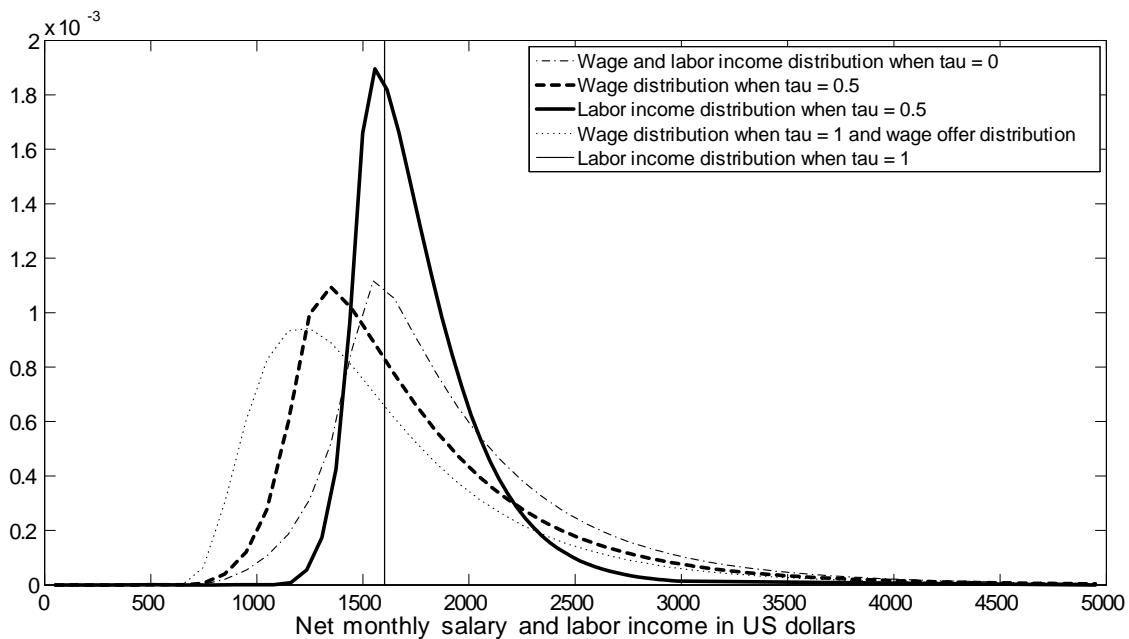


Figure 5: Wage and Labor Income Distributions

Table 2 displays summary statistics of the equilibrium of the economy for different values of τ . As already mentioned, by enhancing the provision of insurance, progressivity reduces incentives to search on the job which translates into a lower search intensity for employed workers. However, from the perspective of an unemployed worker, progressivity reduces the dispersion of offered wages which increases the attractiveness of being employed rather than unemployed. Moreover, as actual wages are higher than offered wages, progressivity slightly increases the mean of offered wages. Hence, as the degree of progressivity increases, the search intensity of unemployed workers rises which reduces the equilibrium rate of unemployment.

τ	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Search intensity employed (%)	1.298	1.134	0.970	0.802	0.632	0.461	0.293	0.137	0.026	0.0002	0.0000
Search intensity unemployed (%)	33.3	36.4	40.2	44.3	48.6	53.6	59.1	65.4	72.0	78.0	81.0
Unemployment (%)	5.00	4.58	4.18	3.81	3.48	3.17	2.88	2.61	2.38	2.20	2.12
Output (\$)	1838	1818	1794	1766	1734	1697	1656	1612	1575	1568	1569
Wealth (\$)	29191	25702	22356	19228	16411	13857	11669	9783	8285	7267	6834
Welfare gain (%)	0	0.024	-0.140	-0.535	-1.203	-2.222	-3.647	-5.466	-7.195	-7.653	-7.634

Table 2: Impact of Progressivity on Equilibrium

By reducing on-the-job search, progressivity discourages workers from moving from low to high productivity jobs. This makes the labor market more sclerotic which reduces

the output level.²¹ The reduction in unemployment induced by progressivity is far too small to offset this effect (except as τ increases from 0.9 to 1).

In their analysis of the Swedish labor market, Ljungqvist and Sargent (1995) were among the first to emphasize that progressivity reduces the rate of unemployment at the cost of a more sclerotic labor market. While the same conclusion holds in the current context, the underlying mechanism is somewhat different. Ljungqvist and Sargent (1995) do not allow for on-the-job search, but assume that wages are exposed to random shocks. Hence, in their model, progressivity reduces the reservation wage of unemployed workers, which induces them to accept a larger fraction of job offers, and it reduces the reservation wage of employed workers, which increases the likelihood that they choose to retain their job in case it is hit by an adverse productivity shock. Both effects concur to reduce the average match productivity, which results in a lower level of GDP.

By contrast, in my model, the reservation wage is always equal to the lower bound of the wage offer distribution, i.e. all offers are always accepted. This results from my calibration where searching for a job is cheaper while employed than unemployed. In my model, progressivity reduces unemployment because workers are risk-averse and value job offers more highly if their dispersion is reduced. This mechanism is absent from Ljungqvist and Sargent (1995) who assume that workers are risk-neutral. Also, I obtain that progressivity reduces output because it discourages workers from climbing the wage ladder, not because workers fail to quit following an adverse productivity shock.

Progressivity reduces the average wealth of individuals. This is hardly surprising as an increase in the provision of insurance against labor income fluctuations reduces the demand for precautionary savings. When $\tau = 1$, the remaining wealth is used as self-insurance against the unemployment risk. The fact that the level of wealth when $\tau = 1$ is less than a quarter of that level when $\tau = 0$ shows that wage fluctuations, rather than unemployment, is the main source of demand for precautionary savings.

If the interest rate was endogenous, then progressivity would reduce the capital stock which would raise the interest rate. In practice, it is however unlikely that the precautionary savings behavior of low skilled workers has any significant influence on the capital stock of the economy and on the interest rate. Hence, a serious attempt to endogenize the interest rate in a closed economy would require allowing for high skilled workers, for life-cycle savings and, potentially, for bequests.²²

Finally, Table 2 shows that enhancing the provision of insurance against wage fluctuations hardly increases the welfare of workers. Indeed, setting $\tau = 0.1$ is equivalent to raising the consumption of all workers in all states of the world in the benchmark alloca-

²¹As the population has been normalized to 1, output corresponds to both total GDP and average GDP per capita.

²²Even though they do not focus on low skilled workers, Conesa and Krueger (2006) find the general equilibrium effects to be rather unimportant for the determination of the optimal policy.

tion with $\tau = 0$ by a mere 0.024%. Further increases in the degree of progressivity of the insurance policy can generate large welfare losses. Thus, with private savings, the adverse moral hazard effect of progressivity on on-the-job search dominates the welfare-enhancing reduction in the variance of labor incomes.

5.2 Optimal Insurance Policy

Let us now characterize the optimal insurance policy. Within the above class of transfer functions, the optimal degree of progressivity is characterized by $\tau = 0.06$ which generates a consumption-equivalent welfare gain of only 0.040%. However, this result about the undesirability of insurance is potentially misleading to the extent that the functional form under consideration imposes the same degree of progressivity at the bottom and at the top of the wage distribution. This is unlikely to be optimal since the intensity of the trade-off between insurance and incentives is not constant along the wage distribution. Indeed, Figure 3 suggests that moral hazard on the job can be a big concern below \$1500, but not above.

Fortunately, it turns out to be possible to characterize numerically the optimal non-linear transfer function. As shown by Figure 3, the moral hazard effect is virtually in-existent towards the top of the wage distribution. It is therefore trivially desirable to provide full insurance against wage fluctuations above a certain threshold. Hence, to determine the optimal schedule $T(\cdot)$, I solve for the welfare maximizing transfer level $T(w)$ at each rung w of the wage ladder while adjusting the constant consumption level at the top, and the corresponding transfer levels, such as to balance the budget constraint (6). I then iterate across all the ladders (below the full insurance threshold) until no adjustment in any of the transfer levels can increase welfare.²³

The optimal insurance policy is shown in Figure 6 which represents the monthly labor income $w - T(w)$ of a worker as a function of his net monthly salary w . The extent of insurance against wage fluctuations is far from constant across the wage distribution. Hardly any transfers are made below \$1450. In fact, the transfers are even negative between \$1250 and \$1450! As the wage of a worker increases from \$1450 to \$1550, his labor income increases from \$1413 to \$2000. This makes the optimal transfer schedule regressive towards the lower half of the wage distribution.²⁴ Finally, there is almost full provision of insurance above \$1550, with all workers employed at \$1750 or more earning a monthly labor income of \$2104.

²³By applying this procedure, I obtain a local maximum of the welfare function. To check that this is also a global maximum, I have performed a grid search on a piecewise linear approximation to the optimal schedule.

²⁴Thus, here in the context of random search on and off the job, as in Golosov, Maziero and Menzic (2012) in the context of directed search off the job, some regressivity is desirable in order to enhance workers' incentives to search for high productivity jobs.

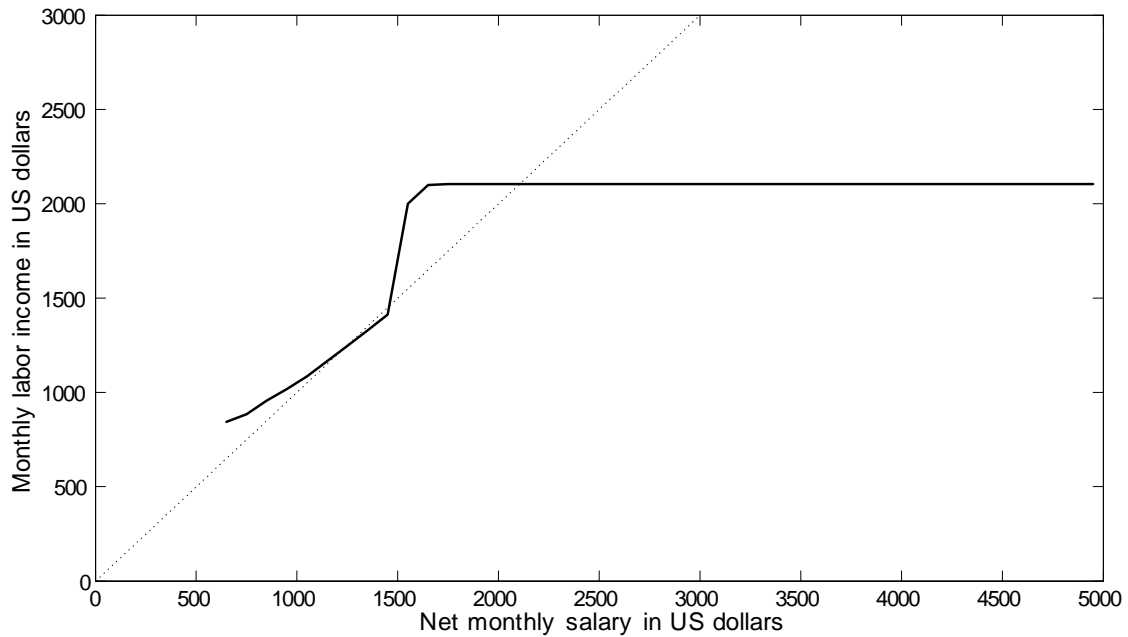


Figure 6: Optimal Insurance Policy

It is not desirable to increase the labor income of workers earning less than \$1450 as this would reduce their incentives to search on the job. Instead, they should rely on private savings together with the prospect of moving to a better paying job in order to self-insure against low wage realizations. By contrast, even without any transfers, workers employed at \$1550 or more hardly search on the job. Indeed, workers employed at \$1750, \$2500 or \$4000 will keep earning the same wage until they become unemployed. They should therefore be provided perfect insurance by all earning a labor income of \$2104.²⁵

Table 3 reports summary statistics of the economy with no insurance and with the optimal insurance schedule of Figure 6. The surprising result is that, not only does the insurance policy manage to maintain incentives to search on the job, it in fact increases them! Indeed, by implementing the optimal schedule, the average monthly probability that an employed worker moves to a better job increases from 1.30 to 1.43%. This is mainly due to the fact that, by eliminating the dispersion of labor income at the top of the wage offer distribution, the insurance policy increases the incentives to search on the job. Consequently, the fraction of employed workers earning \$1450 or less drops from 20.7 to 15.8% (while the wage offer distribution implies that 53.7% of offered wages are equal to \$1450 or less). Figure 7 displays the wage distribution with and without the implementation of the optimal policy.

²⁵The implementation of a very high degree of insurance requires that workers and firms cannot collude by manipulating the monthly salary at the expense of the insurance company. Endogenizing the extent of these collusions is beyond the scope of this paper.

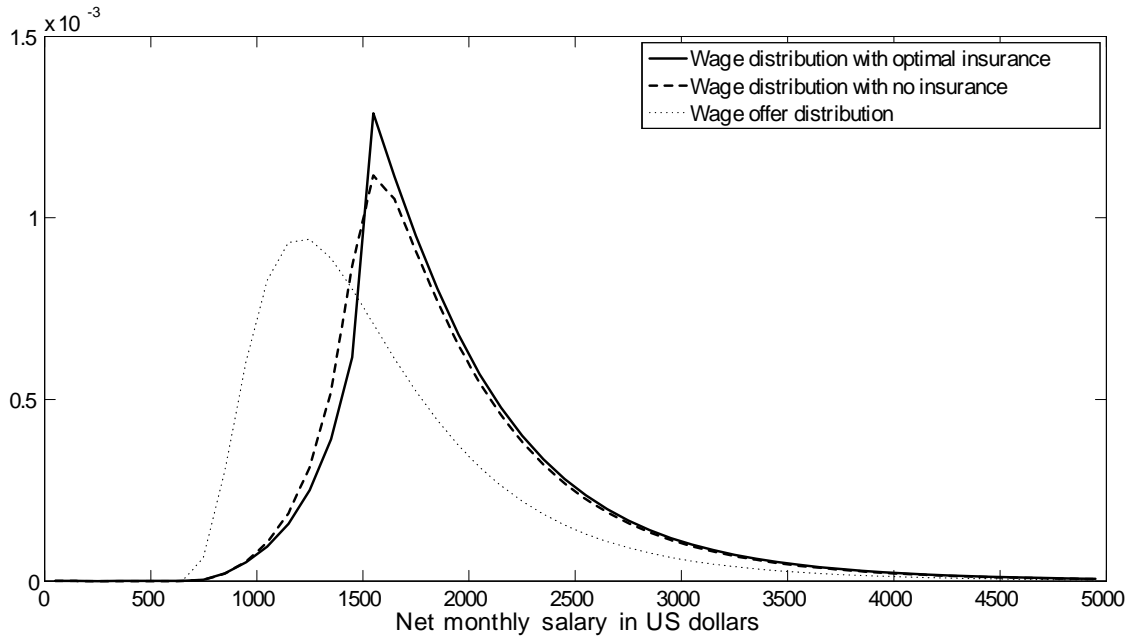


Figure 7: Wage Distribution With and Without Optimal Insurance

By reducing the dispersion of labor incomes among employed workers, the insurance policy makes employment more attractive. This leads to a significant increase in the search intensity of unemployed workers which results in a lower rate of unemployment. A larger number of employed workers together with higher distribution of wages among the employed raises the output level by 2.39%. The average wealth level falls by 38.6%. This is primarily due to the disappearance of the right tail of the wealth distribution. Indeed, the insurance policy eliminates the very high labor incomes which, in the absence of insurance, is a major source of precautionary savings.

	No insurance benchmark	Optimal insurance schedule
Search intensity employed (%)	1.298	1.432
Search intensity unemployed (%)	33.3	40.7
Unemployment (%)	5.00	4.13
Output (\$)	1838	1882
Wealth (\$)	29191	17923
Standard deviation of labor income (\$)	600	293
Standard deviation of consumption (\$)	324	197
Welfare gain (%)	0	1.326

Table 3: Equilibrium With and Without Insurance

Not only does the transfer function increases incentives to search on the job and while unemployed, it also does provide a substantial amount of insurance against wage shocks.

Indeed, the insurance policy more than halves the standard deviation of labor incomes.²⁶ It induces a slightly smaller decline, of 39.2%, in the standard deviation of consumption. The smaller reduction in the variability of consumption is due to the reduction in the accumulation of precautionary savings which hinders the extent to which workers can self-insure against low wage realizations.

While, at the optimum, there is a trade-off between the provision of insurance and the maximization of output, it turns out that, starting from a no insurance benchmark, it is possible to increase both insurance and output. It is therefore not surprising that the implementation of the optimal policy generates a sizeable consumption-equivalent welfare gain of 1.326%.

Finally, note that increasing z such as to enhance the provision $b+z$ of unemployment insurance, while re-optimizing $T(\cdot)$, reduces the welfare of workers. The magnitude of the moral hazard effect of unemployment insurance, together with the short average duration of unemployment spells, make it preferable that workers primarily rely on precautionary savings in order to maintain a high consumption level while out of work.

6 No Savings

While we have assumed that workers choose to accumulate some savings in order to self-insure against stochastic shocks to their labor incomes, the fact is that many households, especially among the low-skilled, do not hold any wealth. Using the U.S. Survey of Consumer Finances from 1995, Wolff (1998) reports a mean net worth of the lowest two quintiles of the wealth distribution of only \$900. Relying on the Survey of Income and Program Participation panels spanning 1985 to 2000, Chetty (2008) finds that, before unemployment, the median liquid wealth net of unsecured debt of a worker is equal to a mere \$128. He then argues that this provides a major justification for a fairly generous provision of unemployment insurance. Similarly, the apparent inability of many households to self-insure by accumulating some precautionary savings could significantly affect the optimal design of insurance against wage fluctuations. In this section, I therefore characterize the optimal policy in the absence of private savings.

The model without savings is calibrated following the same procedure as above. The parameters of the cost functions become $ku = 0.0567$, $\gamma u = 2.7212$, $k = 0.0095$ and $\gamma = 1.2302$. This calibration implies that unemployed workers accept all the offers that they receive, consistently with the identification strategy for the wage offer distribution (summarized by Figure 1).

The calibrated model generates a wage distribution with mean \$1935 and standard

²⁶99.2% of this reduction is due to the transfer function. The remaining 0.8% is due to the slight decrease in the dispersion of the wage distribution which could be seen in Figure 7.

deviation \$603 which is almost identical to that displayed in Figure 2. The key summary statistics of the model without savings are displayed below in the middle column of Table 4. They are almost identical to the corresponding statistics for the economy with savings.

Considering the one parameter family of transfer functions from the previous section, (10), the effect of progressivity on the equilibrium of the economy is very similar to those reported in Table 2 with two important exceptions. First, progressivity hardly has any impact on the search intensity of unemployed workers and, hence, on the equilibrium rate of unemployment. This results from the calibration of the model without savings which imposes a very high cost of searching intensively for a job while unemployed. This feature is necessary to match a monthly job finding probability of only 1/3 despite the low level of unemployment benefits. The second difference is that welfare is maximized for $\tau = 0.42$, a fairly high degree of progressivity, and the corresponding consumption-equivalent welfare gain amounts to 2.59%. Imposing a high degree of progressivity is much more desirable without savings than with, even though the adverse effect on on-the-job search is equally large in both cases. Indeed, in the absence of savings, the provision of insurance is the only way to raise the consumption level of low wage workers.

Proceeding as in the previous section, I have characterized numerically the optimal insurance policy which is displayed in Figure 8. While the shape of the optimal transfer function is similar to the one obtained with savings, the magnitude of the transfers at low income levels is much larger. A worker employed at wage \$650 receives a transfer of \$480 which allows his labor income to reach \$1130. This more generous provision of insurance is paid for by a lower income level at the upper end of the distribution. Workers employed at \$1450 or more receive a labor income of \$1963.

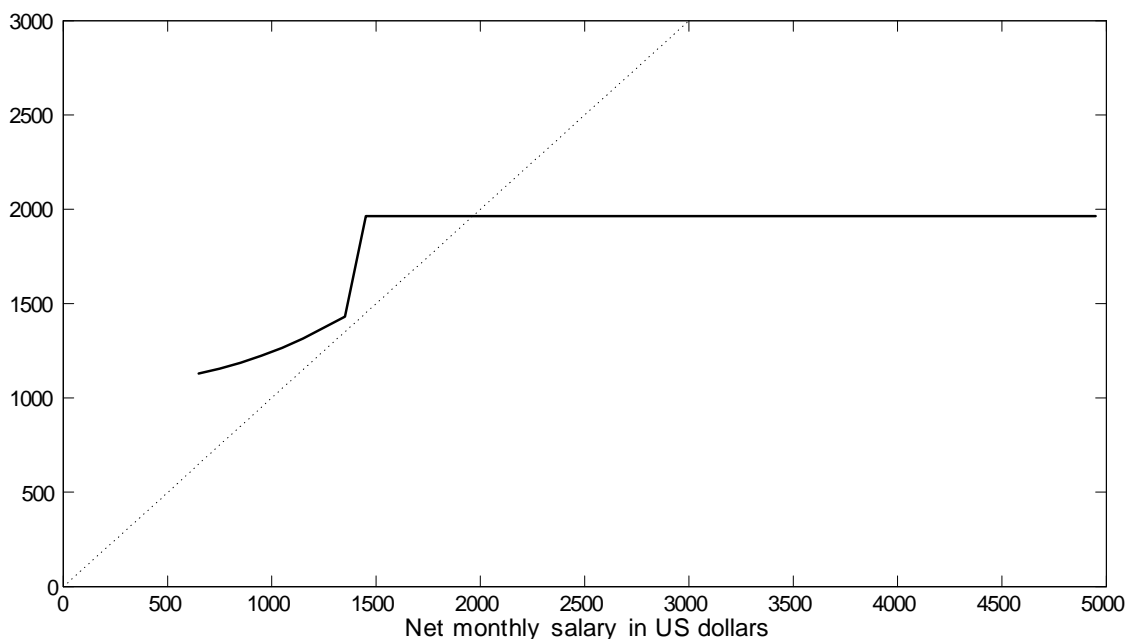


Figure 8: Optimal Insurance Policy in the Absence of Savings

As reported in Table 4, the optimal insurance policy reduces incentives to search on the job. This leads to a 3.75% drop in output. The standard deviation of labor income, and hence of consumption, drops by 62.0%. Clearly, the absence of savings tilts the design of the optimal policy towards a more generous provision of insurance at the expense of incentives to search on the job. Implementing this optimal policy generates a large consumption-equivalent welfare gain of 4.383%.

	No insurance benchmark	Optimal insurance schedule
Search intensity employed (%)	1.314	0.929
Search intensity unemployed (%)	33.3	33.5
Unemployment (%)	5.00	4.97
Output (\$)	1838	1769
Standard deviation of labor income (\$)	603	229
Welfare gain (%)	0	4.383

Table 4: Equilibrium of the No Savings Economy With and Without Insurance

In the absence of insurance, increasing the generosity of unemployment insurance generates large welfare gains. The optimal policy is to set z equal to \$848, which raises $b + z$ to \$1231, together with full insurance above \$1450 and no insurance below that level. Thus, \$1450 becomes the reservation wage and all workers earn \$1800. There is no on-the-job search. The unemployment rate rises to 18.4% while output falls to \$1625 (a 11.59% drop compared to the no insurance benchmark). This fully optimal policy nevertheless generates a consumption-equivalent welfare gain of 28.058%.

7 Conclusion

This paper has relied on a model of the wage ladder to investigate the provision of insurance against search-induced wage dispersion. My first result was that implementing a generous provision of insurance makes work more attractive for the unemployed and, hence, decreases the equilibrium rate of unemployment.

I have then characterized the optimal insurance policy. The key trade-off at work is that an overly generous provision of insurance reduces incentives to move up the wage ladder, which results in workers remaining stuck in low productivity jobs. This explains why the optimal policy is to provide virtually no insurance towards the lower half of the wage distribution, i.e. to the low wage workers who would value it the most. They should instead rely on their private savings to sustain a decent consumption level while seeking to improve their labor income by moving to better quality jobs. By contrast, full insurance should be provided over the upper half of the wage distribution. These workers

are sufficiently high in the wage ladder that they would not be searching for better jobs anyway. Hence, it is desirable to eliminate the risk that determines their exact position in the upper half of the wage ladder.

A surprising result is that, not only does the optimal insurance policy reduce the risk to which workers are exposed, it also increases the production efficiency of the economy. Indeed, in my main calibration, the implementation of the optimal policy reduces the rate of unemployment and enhances the search intensity of employed workers. This induces aggregate output to rise by more than 2%. The optimal policy generates a substantial welfare gain which slightly exceeds 1.3% of consumption.

In the absence of private savings, it becomes desirable to provide more insurance to low wage workers, to an extent that reduces output. Low wage workers should nevertheless still be provided with incentives to search on the job, which explains why their labor incomes remain significantly lower than those of high wage workers.

In this paper, I have exclusively focused on simple history-independent policies. Future work is necessary to determine whether significant additional welfare gains can be obtained by allowing for history-dependence. If the literature on unemployment insurance is any guide²⁷, then the answer is likely to depend heavily on whether or not individuals can accumulate some precautionary savings.

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²⁷Cf., for instance, Shavell and Weiss (1979), Hopenhayn and Nicolini (1997), Kocherlakota (2004) or Shimer and Werning (2008).

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