Unemployment Insurance in the Presence of an Informal Sector

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Abstract

We study the effect of UI benefits in a typical developing country where the informal sector is sizeable and persistent. In a partial equilibrium environment, ruling out the macroeconomic consequences of UI benefits, we characterize the stationary equilibrium of an economy where policyholders may be employed in the formal sector, short-run unemployed receiving UI benefits or long-run unemployed without UI benefits. We perform comparative static exercises to understand how UI benefits affect unemployed workers' effort to secure a formal job and their labor supply in the informal sector. Our model reveals that an increase in UI benefits generates two opposing effects for the short-run unemployed. First, since search efforts cannot be monitored it generates moral hazard behaviours that lower effort. Second, it generates an income effect as it reduces the marginal cost of searching for a formal job and increases effort. Even though in general it is ambiguous which effect dominates, we show that for short durations UI benefits increase unemployed worker's effort to secure a formal-sector job and decreases informal-sector work.

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1 Introduction

Several developing countries have either adopted some protection against unemployment risk or are considering the introduction of unemployment insurance (UI) benefits (for

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example Chile, Colombia, Ecuador, México, and Uruguay). Few studies have analyzed the consequences of UI benefits on labor markets with a substantial informal sector. Developing countries' dual labor markets may reduce the desirability of a UI program because of a moral hazard problem: the unemployed may work in the informal sector while receiving UI benefits (Hopenhayn and Nicolini, 1999, Alvarez-Parra and Sanchez, 2009 and Mazza, 2000). In this paper we want to highlight an important theoretical mechanism absent in the existing literature: UI benefits also generate an income effect that may allow the unemployed to devote less time in remunerated informal activities and consequently devote more time to secure a job in the formal sector.

In order to focus on the moral hazard problem, one of the most pressing issues for a developing country considering the introduction of UI benefits, we adapt a duration model à la Fredriksson and Holmlund (2001) in a partial equilibrium environment *i.e.*, ruling out the macroeconomic consequences of UI benefits. This feature allows us to derive analytical results. In our model the informal sector is sizeable, persistent and the bulk of it cannot be explained by UI benefits. At the stationary equilibrium we show that UI benefits generate an income effect which reduces the marginal cost of searching for a formal job. This income effect increases unemployed workers' efforts at the expense of their labor supply in the informal sector and therefore softens the moral hazard issue that arises from the unobservability of effort.[1] Even though in general it is ambiguous which effect dominates, we show that for short durations UI benefits increase unemployed worker's effort to secure a formal-sector job and decreases informal-sector work. We also show that an increase in UI benefits received by short-run unemployed workers unambiguously increases the efforts of long-run unemployed workers to find a formal job.

2 The Model

We construct a continuous time model in order to analyze the effects of increasing UI in an economy characterized by a significantly sized informal sector. Workers can be either employed in the formal sector or unemployed. When they are employed in the formal sector they receive an hourly wage equal to w^f. Formal-sector jobs are destroyed at a rate ϕ, and workers become unemployed.[2] Unemployed agents can either be short or long-run unemployed. When workers lose a formal-sector job they become short-run unemployed (denoted by index $j = I$) and receive UI benefits. Following Fredriksson and Holmlund (2001), we assume that UI benefits may expire at a Poisson rate, λ, independent of the policyholders' actions. This implies that the expected duration of

[1] This effect is close to the liquidity constraint pointed out by Chetty (2008).

[2] The financial market is supposed to be imperfect, that is, there are not any financial assets that allow workers to be covered against the risk of losing their job.

UI benefits equals $1/\lambda$. When UI benefits expire agents become long-run unemployed, $j = N$, and do not receive UI benefits anymore. Instead, they receive a transfer referred to as subsidy. Formal-sector opportunities arrive at rate p^I for the short-run unemployed and p^N for the long-run unemployed.

When employed in the formal sector we assume that workers split their total time, T, between formal-sector work, h, and leisure, $L = T - h$. Since we want to focus on the consequences of increasing UI benefits on the decisions of unemployed workers, we suppose that the number of hours worked in the formal sector are exogenous. In contrast, when unemployed, either short or long-run, agents split their total time, T, into three activities. First, they can devote s^j units of time to secure a formal-sector job, called effort hereafter. Second, they can work a^j units of time in the informal sector to earn an income. Finally, they can enjoy l^j units of leisure time. The time constraint is

$$s^j + a^j + l^j = T.$$

The total time that an unemployed worker devotes to the informal sector is then given by $T - s^j - l^j$. Crucially, we assume that s^j and a^j cannot be observed, that is, they are private information of the unemployed workers and consequently are not contractible. Moreover, effort affects the rate at which workers find a formal job, $p^j(s^j)$, with $p'(.) > 0$ and $p''(.) < 0$. Finally, when working in the informal sector, which is assumed to be frictionless and without rationing, workers receive an hourly wage of $w^i = kw^f$, where $0 \leq k < 1$. We assume that there exists a positive differential of wages between the formal and informal sectors.

2.1 Workers

Agents are risk-averse and their preferences are represented by an increasing and concave VNM utility function, u. Let V^E be the value of formal-sector employment, V^I the value of the short-run unemployed workers who enjoy UI benefits and V^N the value of the long-run unemployed workers who no longer have access to UI but benefit from a UI subsidy. The flow value of a formal-sector job is

$$rV^E = u(w^f h, T - h) - \phi \left[V^E - V^I \right], \tag{1}$$

where r denotes the subjective rate of time preference. The flow value of a formal job depends on the income obtained and the leisure time enjoyed. A formal worker loses his job with probability ϕ and in this case becomes a short-run unemployed facing a capital loss of $V^E - V^I$.

The short-run unemployed receive UI benefits of $b^I w^f h$, where b^I denotes the replacement ratio. While receiving UI benefits she can work in the informal sector a^I units of time, where she earns an income of $kw^f a^I$. She can also exert effort (s^I) to secure a formal job with probability $p^I(s^I)$, thus realizing a capital gain of $V^E - V^I$. With probability λ, the short-run unemployed becomes a long-run unemployed, loses the UI benefits, and thus faces a capital loss of $V^I - V^N$. The value function of a short-run unemployed is

$$rV^I = u^I(kw^f a^I + b^I w^f h, T - s^I - a^I) + p^I(s^I)\left(V^E - V^I\right) - \lambda\left(V^I - V^N\right). \qquad (2)$$

Similarly, the flow value of being long-run unemployed, without access to UI benefits, is

$$rV^N = u^N(kw^f a^N + b^N w^f h, T - s^N - a^N) + p^N(s^N)\left(V^E - V^N\right). \qquad (3)$$

Long-run unemployed workers earn $kw^f a^N$ from their labor supply in the informal sector and also benefit from a government transfer, $b^N w^f h$. We naturally assume that $b^I > b^N$.

Considering the government's instrument $\left(b^I, b^N\right)$ as given, the unemployed workers in state j choose $\left(s^j, l^j, a^j\right)$, such that $\left(s^j, l^j, a^j\right) \in \arg\max V^j$. The first order conditions of this maximization program yield

$$-\frac{\partial u(kw^f a^j + b^I w^f h, T - s^j - a^j)}{\partial l^j} + \frac{\partial p^j(s^j)}{\partial s^j}\left[V^E - V^j\right] = 0 \qquad (4)$$

and

$$kw^f \frac{\partial u(kw^f a^j + b^I w^f h, T - s^j - a^j)}{\partial c^j} - \frac{\partial u(kw^f a^j + b^I w^f h, T - s^j - a^j)}{\partial l^j} = 0. \qquad (5)$$

Equation (4) shows that an unemployed worker undertakes effort to secure a new job in the formal sector such that the marginal benefit of this effort, composed by the marginal increase of the probability of finding a job times the difference of values between being employed ($j = E$) and unemployed ($j = I, N$), is equal to the marginal cost due to the reduction of leisure. Equation (5) shows that an unemployed worker chooses his level of informal labor supply to equalize his marginal consumption utility to his leisure marginal (opportunity) cost.

2.2 Comparative Statics at the Stationary Equilibrium

Similarly to Fredriksson and Holmlund (2001), we combine (1), (2) and (3) and obtain at the stationary equilibrium:

$$\begin{aligned}
V^E - V^I &= \frac{1}{A}\left[\left(r + p^N(s^N)\right)\left[u(w^f T) - u^I\left(c^I, l^I\right)\right] + \lambda\left[u(w^f T) - u^N\left(c^N, l^N\right)\right]\right], \\
V^E - V^N &= \frac{1}{A}\left[\left(r + \lambda + p^I(s^I)\right)\left[u(w^f T) - u^N\left(c^N, l^N\right)\right] + \phi\left[u^I\left(c^I, l^I\right) - u^N\left(c^N, l^N\right)\right]\right], \\
V^I - V^N &= \frac{1}{A}\left[\left(r + \phi + p^I(s^I)\right)\left[u^I\left(c^I, l^I\right) - u^N\left(c^N, l^N\right)\right] + \left(p^I(s^I) - p^N(s^N)\right)\left[u(w^f T) - u^I\left(c^I, l^I\right)\right]\right],
\end{aligned}$$

where $A = \left(r + p^N(s^N)\right)\left(r + \phi + p^I(s^I)\right) + \lambda\left(r + \phi + p^N(s^N)\right)$. In what follows, we substitute the term $V^E - V^j$ we get at the stationary equilibrium into the first order conditions of the short and long-run unemployed workers. We then perform several comparative statics exercises.

First, let us analyze the effects generated by increasing UI benefits (respectively UI subsidies) on decisions taken by short-run (resp. long-run) unemployed workers.

Proposition 1 *For short-run (long-run) unemployed workers an increase in b^I (resp. in b^N) has ambiguous effects on informal-sector work, a^I (resp. a^N), and time devoted to searching for a formal-sector job, s^I (resp. s^N).*

Proof. Appendix. ■

Let us interpret the results for short-run unemployed workers, the intuition being the same for the results of the long-run unemployed. At the stationary equilibrium the first order conditions of the unemployed workers contain a wealth effect, which mainly occurs at an intratemporal level, and a moral hazard effect, which captures the effects of the next period policy variables on the unemployed workers' decisions.

The condition that determines the effect of UI benefits on short-run unemployed workers' effort s^I is given by

$$\frac{ds^I}{db^I} = \frac{w^f h}{|H^I|}\left[kw^f\left(u^I_{cc}u^I_{ll} - \left(u^I_{lc}\right)^2\right) + \frac{\left(r + p^N(s^N)\right)\partial p^I(s^I)/\partial s^I}{A}u^I_c\left[G^I_{aa}\right]\right], \quad (6)$$

where $\left|H^I\right|$ and H^I_{aa} are positive and negative respectively due to the second order conditions (see appendix for more details). The first term ($kw^f\left(u^I_{ll}u^I_{cc} - \left(u^I_{cl}\right)^2\right) > 0$) captures the wealth effect generated by the UI benefits: Thanks to UI benefits, all else being equal, short-run unemployed workers need to spend less time working in the informal sector and can devote more time to securing a formal-sector job. The second term is due to the presence of moral hazard: An increase in UI benefits in the future reduces $\left(V^E - V^I\right)$, thus weakening incentives to secure a job in the formal sector. The existence of these two countervailing effects generates the ambiguous results for the search effort summarized in Proposition 1.

The effect of UI benefits on the informal-sector labor supply is given by

$$\begin{aligned}\frac{da^I}{db^I} &= \frac{w^f h}{|H^I|}\Bigg[-kw^f\left(u^I_{ll}u^I_{cc} - \left(u^I_{cl}\right)^2\right) - \frac{\left(r + p^N(s^N)\right)\partial p^I(s^I)/\partial s^I}{A}u^I_c\left[G^I_{aa}\right] \quad (7)\\ &\qquad + kw^f u^I_c\left(kw^f u^I_{cc} - u^I_{lc}\right)\left[\frac{\left(r + p^N(s^N)\right)\partial p^I(s^I)/\partial s^I}{A} - S^I\right]\Bigg],\end{aligned}$$

where $S^I = \left(\partial^2 p^I(s^I)/\partial\left(s^I\right)^2\right) / \left[\left(\partial p^I(s^I)/\partial s^I\right)A\right]$.

Interestingly, all else being equal, the same income effect that increases the short-run unemployed workers' effort also decreases the time devoted to informal activities (because of the negative sign preceding it). Moreover, the effect generated by moral hazard on the time devoted to informal-sector work can be divided into two components. The first is given by the second term and captures a moral hazard effect which increases short-run unemployed informal-sector work at the expense of effort. The second moral hazard effect is captured by the third term in the equation and captures the trade-off between informal-sector work and leisure time. If leisure and consumption are complementary goods, that is, $u_{cl} \geq 0$, the income effect and the second moral hazard effect decrease the labor supply in the informal sector. The first moral hazard component is a countervailing effect as it increases informal-sector work. Therefore, the sign of da^I/db^I depends on the relative sizes of these effects.

Corollary 1 *For short durations of UI benefits,* $1/\lambda \to 0$*,* b^I *unambiguously increases* s^I *and decreases* a^I*.*

Proof. Straightforward from (6) and (7) as $A \to \infty$ and $kw^f u^I_{cc} - u^I_{lc}$ has an upper bound. ■

When UI benefits have a very short duration (like severance payments), the income effect dominates the moral hazard effect and increases in UI benefits decrease the size of the informal sector.

Let us now turn to the effect of UI benefits on long-run unemployed workers.

Proposition 2 *An increase in* b^I *unambiguously increases* s^N*; if* $u^N_{cl} \geq 0$ *it decreases* a^N *(and increases* l^N*).*

Proof. See Appendix. ■

Interestingly, Proposition 2 reveals that UI benefits, b^I, generates a moral hazard effect only for the short-run unemployed.[3] An increase in UI benefits may decrease the unemployed workers' effort to secure a formal job while short-run unemployed. However, the existence of UI benefits received by the short-run unemployed unambiguously increases the effort undertaken by long-run unemployed workers to secure a formal job, s^N. This entitlement effect emerges at the stationary equilibrium because $V^E - V^N$ increases with $u^I - u^N$, which in turn increases with b^I. Everything else equal, the increase of UI benefits for short-run unemployed increases the present value V^E, and consequently increases the effort undertaken by long-run unemployed to secure a job in the formal sector. The effects of UI benefits on informal-sector work and leisure time of the long-run unemployed depend on the cross derivative between consumption and leisure.

[3] Note that the subsidy b^N generates for the long-run unemployed a moral hazard effect similar to the one that b^I generates for the short-run unemployed.

Finally, the expiration rate of UI benefits, λ, has a very close relationship with a key feature of UI design. The effects of changes in λ on the time allocation decisions of short and long-run unemployed workers are summarized in the following proposition.

Proposition 3 *An increase in* λ*:*
i) increases s^I*; if* $u^I_{cl} > 0$ *it decreases* a^I *(and increases* l^I*).*
ii) decreases s^N*; if* $u^I_{cl} > 0$ *it increases* a^N *(and* l^N*).*

Proof. See online appendix. ■

An increase in the expiration rate of UI benefits (or a decrease in the duration of UI benefits) reduces the moral hazard effect for the short-run unemployed since, *ceteris paribus*, they have greater incentives to secure a job in the formal sector. In this case, the trade-off between labor supply in the informal sector and leisure time is standard. For the same reason that b^I increases the long run unemployed's effort, an increase of the duration of UI makes V^E more attractive, and consequently gives stronger incentives to the long-run unemployed to secure a formal job. Since $V^E - V^N$ decreases with λ, all else equal, an increase in λ decreases the marginal benefit of effort. Finally, when $u^N_{cl} > 0$ an increase in λ increases the labor supply in the informal sector and leisure of long-run unemployed workers, at the expense of time devoted to securing a formal-sector job.

3 Discussion

In this note, the partial equilibrium set up allows us to derive analytical results on the consequences of increasing UI benefits. Our results reveal that in developing countries with dual labor markets UI benefits generate an income effect, countervailing to the traditional moral hazard effect. Because UI benefits increase unemployed workers' incomes they need to devote less time to informal jobs and, *ceteris paribus,* they spend more time securing a new job in the formal sector. Analytically, in general it is ambiguous whether the moral hazard or income effects dominates. Nevertheless, our results reveal that for very short durations of UI benefits, increases in UI benefits unambiguously increase the effort undertaken and reduce the labor supply in the informal sector.

Our results suggest that developing countries should not be discouraged from adopting UI benefits by the mere existence of the moral hazard effect. However, to be able to characterize the optimal design of UI benefits in developing countries we strongly believe that this analysis must be extended in several ways. This issue should be resumed in a general equilibrium framework that would contain a matching process *a la* Pissarides (2000) in order to take into account the effect of UI coverage on the wage bargained in the formal sector.[4] As it is likely that the design of optimal UI coverage depends on labor market features, this general equilibrium approach should be combined with a calibration strategy using data from specific dual labor markets in developing countries. It is in our research agenda.

4 References

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5 Appendix: Proof of Propositions 1 and 2

Proof. This appendix is organized as follows: First, we calculate the Hessian matrices of both maximization programs, *i.e.* $j = \{I, N\}$. Next, we use them to provide the comparative static exercices that correspond to each proposition.

Let us define the following function $G^j = \left(G^j_{a^j}(a^j, s^j,), G^j_{s^j}(a^j, s^j,)\right) = (0,0)$, where $G^j_{a^j}$ and $G^j_{s^j}$ denote the first order condition with respect to a^j and s^j $\forall j = \{I, N\}$. The

[4] See Albrecht *et al.* (2009) and Bosch Esteban-Pretel (2012).

Cramer's rule yield.

$$H^j = \begin{pmatrix} u^j_{ll} + \left[S^j\right] u^j_l & -kw^f u^j_{lc} + u^j_{ll} \\ -kw^f u^j_{cl} + u^j_{ll} & \left(kw^f\right)^{2f} u^j_{cc} - 2kw^f u^j_{cl} + u^j_{ll} \end{pmatrix}.$$

where $S^j = \left(\partial^2 p^j(s^j)/\partial\left(s^j\right)^2\right) / \left[\left(\partial p^j(s^j)/\partial s^j\right) A\right]$. ■

5.1 Proof of Proposition 1

Proof. Applying Cramer's rule yields:

$$\frac{da^j}{db^j} = \frac{w^f h}{|H^j|}\left[-kw^f\left(u^j_{ll}u^j_{cc} - \left(u^j_{cl}\right)^2\right) + \frac{\left(r + p^N(s^N)\right)\partial p^I(s^I)/\partial s^I}{A} u^I_c \left(kw^f u^I_{cl} - u^I_{ll}\right)\right.$$
$$\left. + \left[S^I\right] u^I_l \left(u^I_{lc} - kw^f u^I_{cc}\right)\right].$$

Similarly, we have:

$$\frac{ds^I}{db^I} = \frac{w^f h}{|H^I|}\left[kw^f\left(u^I_{cc}u^I_{ll} - (u^I_{lc})^2\right) + \frac{\left(r + p^N(s^N)\right)\partial p^I(s^I)/\partial s^I u^I_c}{A}\left[G^I_{aa}\right]\right].$$

Similar computations yield for a^N, s^N and l^N. ■

5.2 Proof of Proposition 2

Proof. Applying the Cramer's rule gives:

$$\begin{aligned} \frac{da^N}{db^N} &= \frac{1}{|H^N|}\begin{bmatrix} G^N_{ss} & -G^N_{sb} \\ G^N_{as} & -G^N_{ab} \end{bmatrix} \\ &= \frac{1}{|H^N|}\left[\left(\frac{\frac{\partial p^N(s^N)}{\partial s^N}\phi w^f h}{A} u^I_c\right)\left(-kw^f u^N_{cl} + u^N_{ll}\right)\right] \end{aligned}$$

Therefore, a sufficient condition to have $da^N/db^I \leq 0$ is $u^N_{cl} \geq 0$. Similarly, we have

$$\frac{ds^N}{db^I} = \frac{1}{|H^N|}\begin{bmatrix} -\left(\frac{\frac{\partial p^N(s^N)}{\partial s^N})\phi w^f h}{A} u^I_c\right) & -kw^f u^N_{lc} + u^N_{ll} \\ 0 & G^N_{aa} \end{bmatrix} \geq 0.$$

Moreover, we have

$$\frac{ds^I}{db^N} = \frac{1}{|H^I|}\begin{bmatrix} w^f h\frac{\frac{\partial p^I(s^I)}{\partial s^I}\lambda}{A} u^N_c & -kw^f u^I_{lc} + u^I_{ll} \\ 0 & \left(kw^f\right)^{2f} u^I_{cc} - 2kwu^I_{cl} + u^I_{ll} \end{bmatrix} < 0.$$

■